Engineering News-Record

Devoted to Civil Engineering and Contracting
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The Final Step Toward Engineering Society Federation

Resolution adopted January 23 by the joint conference of the governing boards of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Society for Testing Materials:

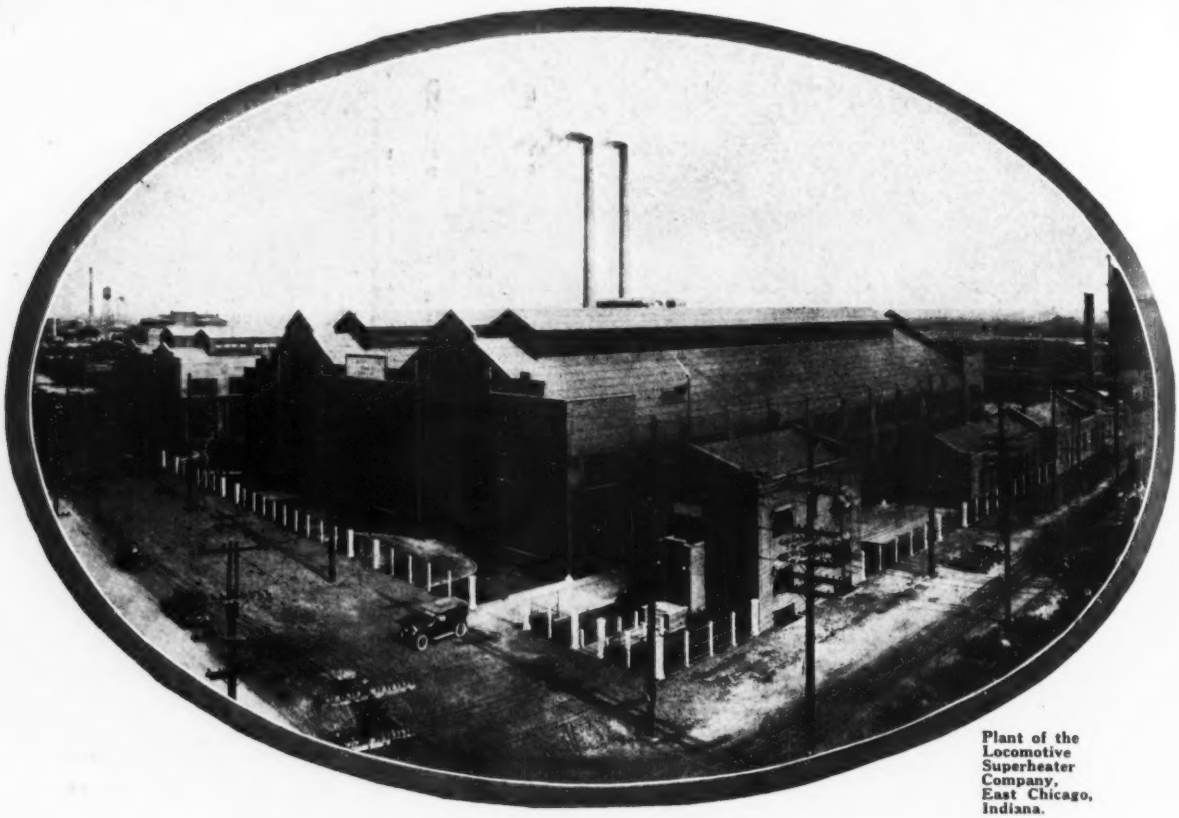
RESOLVED, ***That the conference adopts in principle the report [of the Joint Conference Committee] and requests the Joint Conference Committee to call without delay a conference of representatives of national, local, state and regional engineering organizations to bring into existence the comprehensive organization proposed.***

This brief item, recording the critical step toward federating the engineering societies of the United States, is not only the biggest item of news in this issue, but the biggest item of news of its kind in the engineering history of this country.

Also In This Issue:

The Approval of the Development Report—*An Editorial*

Charles Warren Hunt's 25 Years as Secretary, Am. Soc. C. E.



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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Once More the Architect

JUST as this issue goes to press comes the report, noted in the news pages, by the State Art Commission of Pennsylvania on the proposed Delaware River Bridge. Doubtless the strong engineering organization of Philadelphia will be able to take care of these ridiculous assertions and insinuations, but pending a complete reply it may be well to enter denial that "the great bridges of New York have all been planned by architects." This is as complete a perversion of fact as is the assumption in the report that architects, *per se*, are competent to answer the questions of "what" and "where" in the design of monumental bridge structures.

Parliamentary Procedure

AKNOWLEDGE of parliamentary procedure, we had always understood, should be part of the intellectual equipment of every educated man whose work led him into contact with the world about him. We are of the opinion that the recluse alone can afford to be without such knowledge. Yet at two large and important meetings of engineers last week there was displayed a lack of knowledge of parliamentary procedure that would have shamed a high-school debating society. Robert's Rules of Order can be bought for the price of a good lunch (New York price standards) and can be carried in the pocket. A word to the wise—.

Progress in Contractors' Organization

THE task of organizing contractors, nationally, has progressed to a point of success where unreserved support of the movement can be asked. On Feb. 18 and 19 the Associated General Contractors of America will meet in convention at Chicago. In a little more than a year this association has increased its membership 150 per cent; has formed four active sections and fourteen branches; has formulated a plan of service of wide scope, and has assembled a working organization. It is now in position, with the support of the business, to render actual service to contracting. Contractors in the greatest number possible should attend the Chicago convention.

Rotary Snowplows for City Work

LITTLE has yet been done in the application of power to the removal of snow from city streets. For that reason, particular interest attaches to a machine now employed by some Canadian cities, a description of which will be found elsewhere in this issue, together with figures of comparative cost which indicate the advantage of machine work in both economy and rapidity. It is worth noting that a rotary plow mounted in front of a motor truck was built as an experiment by the South Park Commission, in Chicago. The truck traveled in the cleared path and pushed the plow through the snow, while the Canadian machine as now built is adapted for hauling rather than pushing.

Charles Warren Hunt

THE coming retirement of Charles Warren Hunt as secretary of the American Society of Civil Engineers is an event of major importance to the society. He has been secretary for twenty-five years and in that time the society has grown from a membership of 1,808 to 9,408.

As is usually the case with men of decided convictions, Dr. Hunt has made strong friends and strong enemies. There are those with nothing but praise for his administration, and others who are willing to admit little, if any, good. The truth lies somewhere between.

Much of the criticism of the past has been due to a belief that the society should have been more active and to an impression that the secretary lacked sympathy with the desires of members living outside of District 1. To weigh these matters is out of place here, but it should be remembered that Dr. Hunt was not a sole agent, but that he worked always with boards of direction, which, in theory at least, were supposed, because of their geographic make-up, to know and to express the desires of the membership. To whatever extent criticisms of the society's management may be well founded, no one can assess the blame on individuals without an intimate inquiry into the history of the actions of the board.

But if it is difficult to evaluate the criticism, fortunately the achievements stand out boldly.

We would place as Dr. Hunt's greatest work for the society his influence for the preservation untarnished of its prestige. He had a clear grasp of the purpose of the society and with admirable persistence used his influence to shape all actions so as not to be out of conformity to that end. As we take it, he erected as his ideals the advancement of the profession and of the society through technical work, and the accumulation of membership only in so far as it would be worthy of the society. We look in vain for actions that would diminish the society's technical prestige. On the other hand, we see an ever more careful guarding of committee work, lest something unworthy be produced. We see a constant tightening of the qualifications for membership.

Some there are who would maintain that the society's prestige has been preserved and increased in spite of the administration. We do not believe it. Prestige is a delicate thing, difficult to gain, easy to lose. No loose policy could have maintained it. There are pitfalls in the way always, and only a clear conception of the society's purpose and of the proper means for accomplishing it, combined with a willingness to fight in season and out of season against cross-currents and wrong tendencies, could have kept the organization in its enviable position.

That prestige is the most valuable of the society's possessions. No achievement of any kind, whether of direct aid to the individual, or of brilliant record in

furthering technical progress, or of influencing civic activities—nor the sum total of all such possible achievements—could have atoned for the loss of prestige. Indeed, we do not hesitate to say that if some thing or some things had to be neglected, the less important has suffered. The essential thing has been done: The society's course has been directed along sound lines. Its professional standing today is higher than it has ever been before.

That the profession appreciates this accomplishment is shown by action rather than words. Despite adverse criticism, its growth has been consistent. Members may have protested that they got no return from their membership, but *they nevertheless retained that membership.* Others stated that the only return was the prestige of wearing the pin—*but they continued to pay $15* (and at New York, $25) *per year for that privilege.* Prospective members must have heard the criticism, but they joined nevertheless; the honor of affiliation with the society was alone worth the initiation fee and the annual dues.

An example showing Dr. Hunt's consistent effort to prevent alien activities interfering with technical purposes is afforded by his attitude on the so-called welfare and civic activities. He conceived, as we interpret his course, that these would require, for effectiveness, a type of propaganda which he considered inconsistent with the technical and scientific point of view of the society. Accordingly he advocated the passing of these functions to a separate body. In so doing he did not maintain, if we have sensed correctly his attitude, that the American Society of Civil Engineers had no interest in them. On the contrary, the records of the society show various resolutions of the board on civic topics, while two reports of a committee on compensation and a joint report on licensing bear testimony to the society's recognition of its broad responsibility. What appeared to Dr. Hunt inconsistent with the society's ideals was not the consideration of these civic and welfare topics or action in a moderate way, such as appearance before a congressional committee, but that vigorous type of propaganda such as is being carried on by the National Department of Public Works Association.

In this position we believe Dr. Hunt now has the support of the profession. Much criticism once leveled at him for lack of action on these matters was due to a failure of the critics to see as clearly as he did. He maintained always that these problems needed action; in some cases he pointed out the means of prosecuting some of them before later ardent proponents advocated the measures, but he stoutly insisted that some other body should do the work.

That we have placed no undue stress on the maintenance of the society's prestige, we may advert to the fact that none of the other national engineering societies has an equal standing in the profession itself. It is hard to lay one's finger on the reason, but the extent to which commercial interests have been represented in the management of the other bodies is probably responsible for it. Commercial thinking has diluted the professional viewpoint. Notable examples of this weakening of the professional attitude are afforded by the commercial ventures of the American Society of Mechanical Engineers and the recent casting of their lot with a biased commercial investigating organization—the National Industrial Conference Board —*without question of the danger of the alliance being even so much as raised by the society's leaders,* as represented in its council.

In helping put the American Society of Civil Engineers on a sound financial basis, Dr. Hunt is equally deserving of commendation, and this is said with full realization of the financial difficulties of recent years. The building of the Fifty-seventh Street house and the complete retirement of its indebtedness was a real financial achievement. It was carried on, be it remembered, at a time when the work of the society generally met the demands of the membership; in other words, the building of the Fifty-seventh Street house and the retirement of its indebtedness were not allowed to interfere with the demands of the membership for technical activities. Recent stringency, made all the worse by the demands for increased activities, is to a considerable extent due to the remission of dues on the part of those engaged in the World War. It has been further increased through the great advance which has taken place in the cost of every activity in which the society is engaged.

In general, Dr. Hunt leaves to the society the greatest possible legacy—a heightened prestige and a record of scrupulous adherence to the sound course of professional advancement through high-grade technical work. Clap-trap and commercialism, alien ideas and methods, which have infected other technical societies, had no power with him. He was on sound ground. He knew whether the society should go and refused to allow his ideal of prestige through high-grade technical work and a high-grade membership to be changed. With those standards he measured whatever was proposed. If the plan could not advance the society by methods consistent with these standards he had the courage, no matter what man or group or society made the proposal, to stand out against it.

While, therefore, Dr. Hunt's regime has been subject to criticism, every reasonable man must admit that the society and the profession owes a great debt of gratitude to him. As the future removes us from the record of the past and adds perspective, whatever shortcomings there may have been will dissolve in the strength of the accomplishments. He has helped to bring the society to man's stature, strong in technical prestige, with a healthy, professional point of view. We can wish the next secretary no greater success than that, while removing the grounds for criticism, he may maintain the society's point of view with equal clarity and that he may lay down his charge, when his course is run, with its prestige as great and untarnished.

Every engineer of true professional instincts who abandons strict engineering work to engage in an allied or totally different pursuit makes the decision with grave doubts as to its correctness. In Dr. Hunt's case the event has proved the correctness of his decision of a quarter-century ago. He worked then, he has worked ever since, with men who have written their names large in engineering achievement. They, however, influenced practice in but one line. His influence has been a broader one. He has helped make every engineer prouder of the profession; he has helped every engineer upward through the higher standing that his influence has given to engineering. With this accomplishment the most ambitious might well be proud, and the consciousness of it should be to Dr. Hunt that greatest of rewards, satisfaction with work well done.

Federated and Engineering Societies

ON another page is recorded in a brief article the most important step that has been taken in engineering society organization in this country—a definite move forward to effect a federation of all of the engineering societies, whether they be national, state, regional or local. The drift, of course, has been in this direction for many a year. Engineering Council was an evidence of that drift, and so was the tendency of specialized engineering societies and branches in various cities to form local societies and clubs.

For some time it has been clearly recognized that Engineering Council, with its membership limited to national bodies, could not perform the functions demanded of a large centralized organization of engineers. The Joint Conference Committee, therefore, proposed a comprehensive organization, resting on a democratic foundation. The committee's plan has now been endorsed in an informal meeting by the boards of direction of the five member societies of Engineering Council and they have asked the Joint Conference Committee to call a meeting at which the machinery for the comprehensive organization would be set in motion.

The conference at which this momentous decision was reached was of an informal character and obviously is not binding upon any of the societies. However, there was free opportunity for discussion and the resultant decision will undoubtedly be carried out. The civil engineers' representatives gave notice that the very question up for consideration at the conference was to be proposed to letter ballot of its members and that that ballot must necessarily be determinative of the society's course. However, the fact that the board of direction of the civil engineers has authorized its representatives to engage in the work of preparing for the organizing conference is evidence of the board's sympathy with the project.

The meeting was a remarkable exhibition of a willingness to compromise in order to get results. Even the most conservative had come there with a conviction that action was needed, and were willing to come to any reasonable compromise. Point by point they argued for the largest possible retention of the present characteristics of Engineering Council, but one by one gave way when the inability to maintain that type of organization and get results became apparent. Their concern, as we interpret it, was not to preserve an existing bit of machinery as such, but rather to insure against the turning of engineering influence over to an organization whose standards would be difficult to control and whose influence—and also reaction upon the engineering profession—might be questionable.

As good evidence that the men attending are fully awake to the type of work which, in part, must be done by the new organization, it is encouraging to note the implied approval at the meeting of the work done by the Public Works Department Association. No protest was made against the sums to be appropriated to that activity. That attitude is a guarantee that where virile action is needed, the solid men attending last Friday's meeting will back up plans for vigorous action.

It is unnecessary to remark, of course, that the mere formation of the federation is not a guarantee of success. It will be but a beginning, even though an auspicious one. The federation must be sympathetic with the views of the local bodies and must bend its major efforts to helping them do effective work. A strong headquarters organization will be needed, but the results are to be accomplished largely by proper direction of those on the firing line—the local engineering societies. Failure to catch that point of view will mean, in our judgment, the failure of the proposed body. Naturally, the association of local engineering societies in the federation will help to bring about the new conception. Nevertheless, a failure on the part of the representatives of the national bodies to appreciate the necessity of this attitude may delay very considerably the effective functioning of the new organization.

We believe, then, that the engineering profession in the United States has good reason to be satisfied with the events of last week. The action of the annual meeting of the American Society of Civil Engineers and the determination to go ahead with plans to form the comprehensive organization outlined in the Joint Conference Committee report are epoch-making in the history of the leading national engineering society and of the whole engineering life of the nation as well. We believe that both movements will have the hearty endorsement of the profession. Strong, broad leadership will get tremendous backing.

The Approval of the Development Report

LAST week marked an epoch in the history of the American Society of Civil Engineers.

The annual meeting, by its endorsement of the fundamental recommendations of the development committee, took the critical step of starting the society forward on a more vigorous line of action. The vote of the meeting is not, of course, final. The recommendations must be approved by letter ballot of the members, but if the temper of the meeting was representative of the temper of the society at large, and we believe that it was, the letter ballot will endorse by a large majority the committee's proposals. The action of the meeting is all the more interesting because, while the registration has not yet been analyzed, the majority was probably from the New York Metropolitan District.

The meeting was overwhelmingly in favor of the report. Every vote that, directly or indirectly, favored it was carried by very large majorities, in many cases unanimously. The resolution not merely carried approval of the fundamental recommendations of the committee, but included nine questions which the board of direction was instructed to send out to the members for letter ballot. While the board may add other questions, possibly some that will amplify those approved, the issues raised by these nine are the critical ones. They go to the root of the committee's report. Their approval will mean the launching of the society upon the course of activity for which there has been agitation in recent years.

We pointed out editorially in our issue of Jan. 15 that favorable action would come at the annual meeting only if those who endorsed the report came out for it aggressively. There was nothing to be desired in that direction. If anything, the progressives were too aggressive. It was the first time in a score or more of years that a progressive note was heard; it showed that the membership had determined that the society's life henceforth should be more vigorous. In saying that

we do not mean to imply that radicalism is in the saddle. Far from it. What is proposed is but a logical step beyond the past activities of the society, plus a compliance with the long existing demand that the Society be strengthened in its local and district organization and thus be brought close home to the members. The fundamental purposes remain unchanged.

The note of progressivism, tempered by common sense and the realization of the methods proper for a technical society, was made clearly evident by the remarks of the incoming president, Arthur P. Davis. In what was really a brief inaugural address, instead of a mere speech of acceptance, he declared himself in favor of a progressive policy, for action rather than inaction. If any felt that his words were open to the interpretation of too great a progressivism, his position was made clear at the afternoon meeting. Speaking to a motion, he distinguished between progressivism and radicalism. So far, therefore, as he can guide it, and the influence of a president is necessarily and properly large, the expansion program when approved by letter ballot will be developed along sound lines.

It is regrettable that so much time was wasted on parliamentary tangles and scattering discussion of the main resolution that the merits of the development committee's recommendations were not discussed. We do not believe that such discussion would have altered materially the action of the meeting, though there is a possibility that amendment of one or more of the questions carried by the resolution would have been suggested. What would have been accomplished, would have been to throw the recommendations into relief and bring out what solid objections there may be against them. Such a discussion would have furnished material that could be laid before the members to help them in deciding how to vote on the letter ballot. As we have previously indicated, we find only two objections to the main recommendations of the committee; we feel that the change that would require an applicant to become an associate member for two years before becoming a full member is inadvisable, and we believe that something is to be said against the allocation of all members to sections. The first of these is not covered by the questions approved by the meeting. The section matter is.

Undoubtedly we want to strengthen the sections. In the past they have not been a general success. In fact, only a few have more than a paper existence. To appropriate part of the dues to them on the basis of all the members who will be allocated to a section, even though they live a hundred miles or more from the section city, can be justified only if the sections become virile organizations and contribute to the advancement of the profession. Then there will be general benefit in which even the distant member will share. The experiment is worth trying, with the understanding that each section will be held to severe accountancy for results. In fact, if approved, the rules when adopted should vest in the board of direction discretionary power so that appropriations may be a means of insisting on truly meritorious work.

The society, then, it seems likely, will shortly be embarked, provided always that the needed funds are forthcoming, on an enlarged activity. With that there is, we believe, very genral sympathy. But we should not be so blind as not to realize the dangers of the situation. When one course has been held so long, there is langer that in taking the new one progress will be too fast—and that there will be regrets. We are going to attempt much in a short time—or rather, many will demand that much be done at once. Patience will be desirable—not tolerance of needless delay, but patience with those who will shoulder the load of working out details. The definite course has been set in the new direction. Let us travel along it only with speed consistent with a testing of the various steps. So only can the great traditions of the leader of American engineering societies be preserved and enhanced.

The Alvord Report

THERE was placed in the hands of those attending the annual meeting of the American Society of Civil Engineers last week copies of the report of the committee (of which John W. Alvord was chairman) appointed by the Board of Direction to study the report of the committee on development and report back its conclusions to the board. Obviously, there was not time at the meeting to study this rather lengthy document and consequently the comment on it was very brief, and confined to those members of the committee on development who had read advance copies. The report is devoted most largely to that section of the development report dealing with the proposed joint activities with other societies.

In its handling of that matter the Alvord report, in our judgment, fails entirely to sense the direction in which the development of engineering society activities in this country has been proceeding for the last decade. The outstanding objection which the Alvord report brings against the development committee's proposal is that it will not allow the national engineering societies to be the "dominating influence." In so putting the matter the Alvord committee fails to appreciate that the strength of the engineering profession in this country is to be developed by strengthening the local engineering societies, rather than in further concentrating influence at New York headquarters. In fact, the action of the annual meeting in approving the report of the committee on development was a compliance with the demand that the local sections and the districts be made strong factors in society affairs. The whole tendency in recent years has been to strengthen the locals, and to rely upon them for such action in civic and welfare matters as would accomplish results.

Essentially that which has been developing is a demand for a more democratic government of engineering societies, for a recognition of the purpose and usefulness of local bodies. The Alvord report distinctly recognizes the function of local units, but, turning its back on the movement of a decade, declares for autocratic organization, against which the Joint Conference report is, in its very essence, a protest. Reporting on a democratizing document, the Alvord report proposes autocracy.

The report, like so many other pleas to keep control of the country's engineering society activities in a body fashioned on the plan of the present Engineering Council, is based on the assumption that the leaders of locals are inimical to the national engineering societies. We do not believe that to be true. The leaders of local societies in all but rare cases are members of the national societies and proud of that membership. We do not believe that they would countenance any action harmful to the nationals.

The Alvord report, in our judgment, proceeds along the wrong lines. If it be fully understood we do not believe it will gain any material volume of sympathy.

Earth Foundations and Science

OLDEST of the building arts, foundation construction should be the most thoroughly developed. Before the earliest builder could erect his first structure he had to provide a base for it, and his first observations were concerned with the insufficiency of this or that form of footing. The builders of each succeeding age daily had to consider how to construct a foundation on earth, what form it should have, how deep it should be carried, and how large it must be to bear the intended load. Coming down to modern times, the development of scientific inquiry and analysis would naturally subject these experiences to the test of rational calculations; and so we have today—or should have—a most thoroughly developed engineering science of foundation construction.

The facts disagree sharply with this conclusion. Foundations are peculiarly a field for empiricism, in other words for judgment or guesswork. The master craftsmen in this field—and they are few and little esteemed—are artists rather than scientific workers. We have a foundation art, but we have no corresponding science. Not even a beginning has been made toward subjecting foundation work to the methods of measuring and weighing and subsequently bringing service and material into correspondence by which all the other constructional arts have been raised to that scientific level which is the boast of modern engineering.

So little progress has been made in the study of foundations (or should we say, so little study has been given to the subject?) that it is possible to state in a few sentences the essentials of what is known concerning the common type of foundations, thus: (1) We know that a footing which bears on the ground surface is insecure, not only because its initial resistance to settlement is uncertain, but primarily because it may be affected by many kinds of disturbance. In minor degree disturbances of various kinds affect footings at shallow depth also, of depths from 2 to 6 ft., or in river bottoms even 10 to 20 ft. (2) Except under very special conditions, foundations may be compared on the basis of average load per square foot of horizontal base area. (3) Safe intensities of loading range from ½ to 10 or more tons per square foot, a range of possibly 1 to 50. (4) Some settlement or compression occurs in every case, but the amount that is allowable depends on circumstances. (5) Generally speaking, coarsely granular material is a stronger and more dependable foundation bed than fine-grained material, especially if the latter is of such nature as to be plastic when wet.

Whether or not this list of principles is complete, it is certain that a few general statements of similar character will cover all our underlying knowledge of the subject. It is to be remarked that this is all empirical knowledge. A single principle of scientific or theoretical nature is to be added, but this expresses a hypothesis rather than a known fact: that a foundation bed is elastic in such a way that compression and load are proportional. Utilizing this principle, we convert load distribution into stress distribution just as we do in computing the stresses in a block carrying a non-central load. This meager equipment of rough principle is all that our many centuries of experience has yielded; hardly a satisfactory foundation stratum for a practical science.

Part of the long experience record on foundations is an ample list of failures. Some arts suffer in development because failures are so infrequent that they do not furnish a sufficient check on current methods of planning, but this is not the case with foundations. If not actual collapse, at least undesired settlement has been and is extremely common. Very few earth foundations indeed maintain the structures that rest upon them in complete structural integrity. But the difficulty with the unlimited amount of experience on foundations is that the several items of experience remain individual and do not agglutinate, because of the very nature of the subject. This is the real reason why there has not come into being a broad solid substratum of consistent empirical practice on which scientific development might be based, and the reason why no science of foundation has been created.

Obviously, then, it will be necessary to attack the problem by way of laboratory investigation. Little research work of the kind has been done so far and that little is of vanishingly small significance at best. It must be the work of the future to initiate and carry out investigations on which a science of foundation construction can be built up.

Characteristic of the foundation-building art is the fact that we have a fairly good grasp of one-half of the problem, namely, the measurement of loads and the selection of tools. We possess a broad range of structural types of foundations, extending over piles, spread slab footings, and deep piers; and an even more notable list of construction methods ranging from open excavation and box and sheetpile cofferdams to pneumatic caissons. Having these ample resources it is the more striking that we know little beyond a few primitive facts concerning the other side of the problem, embracing measurements and definite valuation of the materials on which we must found.

Development of a science of foundation is wholly a matter of investigating foundation materials and studying the manner in which loads affect these materials. The distribution of stresses under foundations and the way in which these stresses affect different soils are subjects even more deeply involved in ignorance than soil classification and determination of soil resistance. Work has been done on the latter subject during the four or five years just past, most of it by a committee of the American Society of Civil Engineers. But this work, while of no inconsiderable amount, is chiefly important as showing what a vast quantity of effort must be put on the subject in the future if tangible results are to be reached.

Every encouragement ought to be given to this work and all other work that may be undertaken in the study of foundation problems. The spirit of determined scientific attack on practical problems that prevails today is such as to warrant a strong hope that the art of constructing foundations will not be left forever in its present crude state. Whether the road to an improved condition lies through research organized on a large scale, or through expansion of the present system of scattered individual study of particular questions, cannot safely be foretold. But the great first need is a more general and more aggressive appreciation of the complex problems that are contained in the subject.

Charles Warren Hunt Relieved From Active Duty as Secretary, Am.Soc.C.E.

After 28 Years of Continuous Service, 3 Years as Assistant Secretary and 25 Years as Organization's Executive Head, He Is Appointed to New Office of Secretary Emeritus

CHARLES WARREN HUNT, secretary of the American Society of Civil Engineers, after 28 years' continuous service—three years as assistant secretary and 25 as the association's executive head—has asked to be relieved from active duty. The Board of Direction, by resolution passed Jan. 21, continued him in office until his successor is appointed, and appointed him to the newly created office of Secretary Emeritus, such appointment to take effect upon the election of his successor. The full text of the resolution of the Board of Direction appears on the following page.

Secretary of American Society of Civil Engineers Whose Relief From Active Duty Terminates a Period of 25 Years' Service as Executive Head of the Organization

DR. CHARLES WARREN HUNT

To Dr. Hunt's administrative ability, sound judgment in matters of business and finance, and constant vigilance in maintaining high professional standards the organization is largely indebted for its growth in membership and technical prestige. Throughout the texture of the society's history during the last two and one-half decades his influence is closely interwoven. A member of the Board of Direction, participating in the organization's councils, and notable as a man of exceptional mental alertness and positive opinion, the imprint of his strong personality stands out sharply in the policies and decisions by which the society has been governed. Even in the high office he occupied a less forceful character might easily have become merely a routine man — a chief clerk, concerned principally in the intricate office detail involved at the headquarters of an organization of 10,000 men. Not so Dr. Hunt. While he developed an efficient staff for handling the office routine, supervised its operations closely, and himself devised and introduced many improvements in the system of handling the ever-increasing volume of business of the secretary's office and the library, he never allowed himself to be diverted from the broader field of effort which his position offered to a man able to visualize its real scope. It is natural, after so long a term of office, to think of Dr. Hunt only in terms of the secretaryship of the American Society of Civil Engineers. He was, however, engaged for 16 years in the practice of engineering before he entered upon what was to be his life work. Born in New York City, May 19, 1858, he was graduated at the early age of 18 years, from New York University with the degrees of B.S. and C.E. in 1876. His professional experience from that time on until 1892, when he became assistant secretary of the American Society of Civil Engineers was varied, and included work on municipal docks, parks and water-works as well as railroads and elevated railways. At various periods he worked under the direction of the late Charles T. Brush, M.Am.Soc.C.E., and for a number of years served as assistant to the late J. James R. Croes, past - president, Am.Soc. C.E.

While serving on the Brooklyn elevated railway under the late Othniel F. Nichols, then a member of the society's Board of Direction, Dr. Hunt was elected assistant secretary of the society, a newly created office. At that time the society could afford to offer a salary of only $2,500 a year, and although its acceptance meant a sacrifice of about $1,000 annually, Dr. Hunt, seeing an opportunity for service to the profession not then clearly visualized by the majority of its members, gave up his professional prospects and became assistant secretary on March 2, 1892.

Previous to 1894 the secretary was elected by popular vote, but during that year the constitution was changed and the election of the secretary was placed in the hands of the Board of Direction. At the end of that year Dr. Hunt had become thoroughly familiar with his duties and had so convincingly demonstrated his capacity that

when the Board of Direction met at the annual meeting in 1895 he was elected to the office, to which he has been re-elected each year.

From the time of his election there has been no let-up in activity. The work, involving as it did a contact—and sometimes a clash—with other men in forming and carrying out the society's policies, an opportunity to raise the organization to new heights of usefulness, and the occasion for combatting influences which aimed at the use of the society for selfish ends, furnished to the new secretary the kind of occupation which appealed to him. He was young, energetic and had definitely formed ideas of how the society, under the stimulus of proper leadership, could be developed into a great national force. To the realization of these plans for the organization he devoted his entire effort.

A full historical account of the progress of the Society during these years was written by Dr. Hunt and may be found in the *Transactions*. He has been responsible for improved methods of handling the business of the Society, many of which have been followed by similar organizations. Among his achievements the following stand out conspicuously.

(1) The consummation of the project for the society house at 220 West 57th St., which served its purpose admirably for more than 20 years, and would have continued to do so for many years to come had it not been determined that for purposes of co-operation it was wise, even at great pecuniary sacrifice, to become one of the Founder Societies in the ownership of the Engineering Societies' Building.

(2) The improvement in the society publications in volume and in form, due to his careful editorial supervision.

(3) The International Engineering Congress held in St. Louis in 1904. For the whole work of this congress, the securing of international papers covering the entire field of engineering, then translating, editing and publishing them, the expenditure of the funds of the society for the purpose, all arrangements for the reception of foreign representation, including a large body of members of the Institution of Civil Engineers of Great Britain, Dr. Hunt was responsible. Resolutions of the Board of Direction adopted at that time show its appreciation and recognition of the work.

(4) The cataloging of the library of the society, begun in 1898 and finished two years later, which resulted in its greater usefulness and contributed to its growth from about 30,000 to 89,000 accessions. In this connection he was the pioneer in the making of "searches" for non-resident members, now so successfully carried out by the United Engineering Society Library.

During these years, in addition to the regular duties of his office, Dr. Hunt has been a member of many committees. He was active in the organization of the John Fritz Medal Board of Award and served as one of the representatives of the society for fifteen consecutive years. He was secretary of this board for the first 9 years of its existence, relinquishing that office at his own request and then, upon being elected as chairman, he has served as a representative of the society on many joint activities such as Engineering Foundation, United Engineering Society, Engineering Societies' Employment Bureau, and others.

It is generally felt among the membership that the society owes most to its secretary for his exceptionally able conduct of its finances. Under his management, and while other organizations were floundering helplessly, the affairs of the American Society of Civil Engineers were, from the very beginning of the Hunt regime, conducted on a sound business basis so that the organization enjoyed the prestige, practically unknown at that time, of being in a healthy position financially.

The secretary's work has brought him in contact with engineers throughout the country and, being by nature a keen observer of men, Dr. Hunt has formed very definite opinions as to the strength and the weakness of the engineer as a collective individual. To his friends Dr. Hunt has often expressed the belief that the chief obstacle in the way of the engineer's attainment of adequate recognition by the public and increased compensation is the lack of those things which are part of the make-up of an educated, cultured man. The engineer is a specialist and by the nature of his work allows himself to acquire a narrow viewpoint. Dr. Hunt is of the opinion that engineers, taken by and large, lack imagination, although no one is stronger than is he in endorsing their mental ability and their effectiveness in their special lines of work. Dr. Hunt is of the opinion that this broadening influence which he feels engineers need must be begun in our schools and continued, by the engineer himself, after graduation. This subject is one of the secretary's particular hobbies and on many occasions he has urged his point of view. "Engineers," said Dr. Hunt on one occasion, "are the best set of thinking men in the country; they can work effectively on almost any project except one that involves their own welfare." No man in this country has had a better opportunity to judge engineers than

Resolutions Adopted by the Board of Direction

American Society of Civil Engineers, Jan. 21, 1920

WHEREAS, Dr. Charles Warren Hunt, after 25 years of devoted and efficient service as Secretary of the American Society of Civil Engineers, during which he has contributed to its upbuilding and prosperity to a degree which places the Society under lasting obligation to him, has indicated his desire to be relieved from active duty, and

WHEREAS, he possesses an intimate knowledge of the business of the Society and an extensive acquaintance with its membership which render his advice and assistance of the greatest value to the Society and its Board of Direction, the benefit of which they can ill afford to lose, therefore be it

RESOLVED, that Dr. Charles Warren Hunt be and is hereby appointed Secretary Emeritus of the American Society of Civil Engineers at a salary of $9,000 for the coming year, and a salary of $6,000 per annum thereafter with such duties as the Board of Direction may assign to him.

It was voted that the salary of the present Secretary be continued at $12,000 per annum until his successor is appointed; then to continue at $9,000.

It was unanimously voted that Secretary Charles Warren Hunt be granted leave of absence for six months owing to the condition of his health, and that his service as Secretary Emeritus begin when his successor takes office.

has Dr. Hunt. It is, therefore, significant that he places the lack of a broad education first in the defects in the engineer's qualifications for a bigger place in the world's work.

In an organization of nearly 10,000 men it would be an impossibility for a secretary so to conduct the affairs of the organization as to please everybody. Dr. Hunt, like all men of decisive character, has his enemies and his friends. Both groups are equally positive in their support or in their criticism of him. It is the universal belief, however, that his administration of the secretaryship has been efficient and untiring. The Society today occupies a position of financial stability and great potential influence and it is upon that foundation, in the building of which Dr. Hunt took so important a part, that the structure can be carried upward to new heights of service to its membership and to the nation.

Demountable Bodies for Motor Trucks

OWING to the increased use of motor trucks for freight transport in England, considerable attention has been given to the design of mechanical appliances for loading and unloading freight. Realizing that the time lost by a motor truck at its loading or unloading point in the transference of its freight represents idle capital, British mechanical engineers have co-operated with the automotive engineers in producing those aids that will cut the loading and unloading time to the minimum. At a meeting of the Institution of Mechanical Engineers in London, discussion was given the design of various types of loading and unloading devices.

The general discussion indicated that demountable bodies must be supplied to vehicles so that they may be adaptable for all sorts of haulage. However, discussion was centered upon providing a clearing house for the receipt, storage and distribution of motor-truck freight, and upon such means as would allow all freight-carrying vehicles to spend the least time possible at terminals.

Among the types discussed were those represented in Fig. 1. The first of these shows a demountable body used where no means exists for supporting the bodies when demounted, and consists in providing special legs

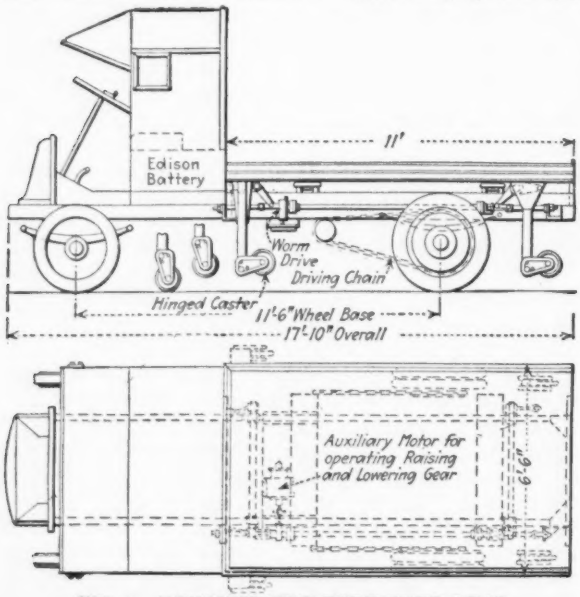


FIG. 1. DEMOUNTABLE BODY WITH LEGS

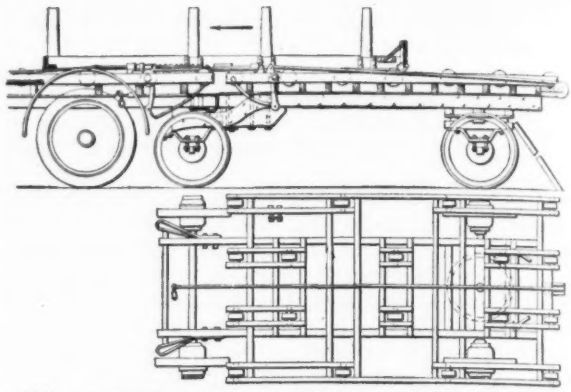


FIG. 2. BODY BEING TRANSFERRED FROM LOADING TAILER TO MOTOR TRUCK

with hinged feet which are turned up out of the way to give road clearance when traveling. The illustration shows such a body fitted to a two-ton electric vehicle. In loading gear is driven by a separate small electric motor which is arranged with an automatic cutoff to prevent overrunning. To provide for easy entrance of the chassis under the body the front legs of the latter are made to pull out to give additional clearance, and when pushed in to the normal position present no obstacles to traffic. The lifting gear of this description allows the driver to discharge a loaded body and take on another in a very few minutes.

The second type is one of a number of methods employing bodies which can be rolled off. Fig. 2 illustrates such a body which is known as the Stamper loading truck. In this system, at each end of a journey a trailer is provided onto which the body is transferred from the truck by means of a winch. The trailer is arranged with the standard type of forecarriage and draw-gear which enables it to be moved if desired. The trailer has no springs, so that the height remains constant, and consists of a framework provided on the top with a number of rollers, a similar set of rollers being fixed on the motor chassis. The tail end of the trailer is formed with sloping guide plates which engage with rubbing plates attached to the rear of the motor vehicle, so that when backed together their height and that of the two sets of rollers are the same. A certain amount of play is also allowed on the axle arms to facilitate centering. On the under side of the body four angle irons are fixed lengthwise, which act as runners and prevent side movement. The method of operation is, for the motor vehicle on its arrival at the loading point, to back up to the loading truck so that the foot irons enter the guides on the rear of the truck, and, further backing taking place, the foot irons slide up these, insuring that the two platforms are brought to the same height. By means of the winch on the motor the body can then be drawn across into position, where it is automatically locked as it passes over a pair of spring-operated bolts. The mechanical engineers also turned their attention to the discussion of trailers, the general opinion being that while under favorable circumstances a certain advantage was had in enabling a greater load to be hauled by the same power unit, the wholesale adoption of trailers behind ordinary vehicles carrying loads was not justified, as "a trailer takes power to haul it, reduces the speed of working, accelerates depreciation of the mechanism, and increases tire wear."

Low Pay of City and State Engineers Disclosed by Answers to Questionnaire

While Living Costs Mount 90 Per Cent Technical Men in Public Service Work Get Increases of Only 17 and 30 Per Cent—Many Views on Morale are Expressed

THE pay of engineers in the service of 35 different states and 66 different cities of the United States has been reported in detail to the State, County and Municipal Sections of Engineering Council's Committee on the Classification and Compensation of Engineers. The main features of the report, recently made public, are given below:

The total number of engineers covered by the returns are 2,222 in state service and 3,317 in city service. Of these engineers, 2,644 are in the grades classified by the committee under professional service and 2,895 are in the lower grades, designated "sub-professional" service. The committee believes that the engineers covered by its returns comprise a little over half the total number of engineers in state service and about two-thirds of those in the employ of cities of over 100,000 population.

The accompanying tables show the compensation received by these engineers. It will be seen that the 2,222 engineers in state service have received, since July 1, 1915, an average increase in pay of 30 per cent. The average increase to the 3,317 engineers in city service during the same time has been only 17 per cent. The increases have been chiefly to the men in the lower grades. Engineers in the higher grades have received very small increases in salary and in many cases none at all.

These figures for salary increases should be compared with the increase in the cost of living, which from Dec. 1, 1913, to Dec. 1, 1919, is fully 90 per cent, according to statistics presented in another appendix to the general committee's report.

The committee requested the heads of departments reporting to state what increase of salary they would recommend for the engineers in various grades. The average increases recommended over the salary rates of July 1, 1915, are, for the state service, 55 per cent, and for the municipal service, 40 per cent. The actual and recommended percentage of salary increases for both professional and sub-professional workers in both services are as follows:

	State Per Cent	Municipal Per Cent
Actual increase in compensation for all positions since July 1, 1915—Sub-professional..	30	18.5
Since July 1, 1915—Professional.....	30	6.5
Since July 1, 1915—All Services.....	30	11
Recommended increase in compensation for all positions as compared with compensation on July 1, 1915—Sub-professional.....	48	47
July 1, 1915—Professional.....	72	36
July 1, 1915—All Services.....	63	40

In the returns for the municipal service it appears that about 6 per cent of the increased compensation reported has been an incident growing out of a promotion to a higher grade. In the higher grades of professional municipal service, therefore, there has been practically no increase in the last four years to compensate for the decreased value of the dollar.

The false economy of perpetuating such conditions, and their seriously prejudicial effect upon the engineering service as a whole has been pointed out by the main committee. Correction of these difficulties constitutes a serious problem, for which a satisfactory solution must be found for the benefit, not only of the engineers but also of the services affected.

The accompanying tables show that the average age of men in all grades of the state service is very much lower than in the corresponding grades of municipal service. This is probably due in part to the fact that many of the state engineering departments have been organized at a very recent date. The tables show that the average present compensation for the higher professional grades in municipal service is very much above that in the state service, as is the compensation recommended, and that the present as well as the recommended rates for the lower grades are generally very much alike in both services.

It is probable that since the data were furnished to the committee, some progress has been made in the direction of bringing about increased compensation, but the only specific instance at hand is in New York City, where provision has been made in the 1920 budget for raising salaries of *all* employees receiving a salary of $2,600 or less per annum on the following basis:

Up to and including $1,200 per annum, 20 per cent with a minimum of $100 where any increase whatever is given, and a maximum of $200.

Between $1,201 and $1,900 per annum, 15 per cent where any increase is given, with a maximum of $200.

Between $1,901 and $2,600 per annum, 10 per cent with a minimum of $200 where any increase is given and a maximum of $250.

At the same time increases were granted to a few engineers in higher grades but this was the exception rather than the rule.

Engineers' Salaries Below Living Wage

Considering the average present compensation reported for the various positions, it will be seen that in the sub-professional service and in the two lowest grades of the professional service, which together comprise 86 per cent of the total number of engineers, concerning whom data has been obtained, *the average compensation is less than $2,200*, which is the estimated bare cost of living for a moderately small family. The average compensation for even the highest grades is utterly incommensurate with what should be expected, particularly when compared with the pay generally received by engineers not in public service.

It is inconceivable that work so poorly paid can be other than expensive, for men thus circumstanced cannot be expected to perform their duties in other than a perfunctory manner or to produce more than a small fraction of what they otherwise might. It is safe to say that suitable compensation for high-grade engineering service is a real economy, and that the requirements of state and municipal work are invariably such as to demand the best.

Why Men Stay in City Service

The advanced age of men in the sub-professional grades and in the lower grades in the professional service reveals a condition which requires correction, especially in the municipal service. It is doubtless due

to the fact that in normal times municipal service attracted young men about to enter upon their career as offering compensation greater than could be obtained elsewhere, and who did not appreciate the narrow field open for advancement until after they had been so long in the service that their usefulness in other fields was too limited to enable them to change without taking less money and assuming a risk as to permanent betterment.

An intervening increase in the number of dependents has probably added to their timidity as to the wisdom of making a change, with the result of creating a condition in public office which is usually described as "few die—none resign." The failure to provide room at the top naturally holds men in the same position, with their future prospects limited to the opening of new activities or the chance of occasional reward for continued service.

Under existing conditions, it would seem that men of courage and ability might be expected, when practicable, to seek other service, while the class that remains would naturally include not only the less independent and self-reliant, but also all those of lesser talent who depend upon the sheltering protection of civil service rules and regulations to continue in a job. If this is not the case, it seems difficult to understand why such a large proportion of municipal and state employees remain in service at a compensation less than that considered to be a living wage.

How to correct this condition is a problem for which the committee is not at this time prepared to offer a solution, but it seems clear that if public service is to be maintained on a high plane, it is necessary to continuously replenish its ranks with at least a substantial percentage of men having the enthusiasm which comes from incentive and to drop out those who might do better in other fields before they have settled down to a mental and professional condition of stagnation.

Some of the difficulties which must be met in bringing the state and municipal service to a higher degree of efficiency and, incidentally, in correcting existing conditions in such a way as to retain good men, are brought out in the report of the United States Civil Service Commission for the year ending June 30, 1919, from which the following quotations are made:

This serious loss of valuable employees, who have acquired experience and become useful, is due to their leaving to go into outside employment, largely because of the lack of opportunity in the Government service. The higher positions, such as chiefs of bureaus, are rarely filled by promotions, not having been brought within the competitive system, and there is not sufficient inducement for the most capable men and women to enter the examinations, either in the salary immediately offered or in the prospects of a career. The service, therefore, tends to be regarded as a mere makeshift, and the tendency is for the most capable of those entering it to seek outside employment.

Public office should not be regarded as a gratuity, but as an opportunity for service to the community by those most fitted to perform that service. To the extent that public office is an honor and a means of livelihood, all should enjoy equal opportunity to compete to gain such honor and livelihood. . . .

The training of an efficient civil administrative officer is a long and expensive process, and unless the best possible material is available from which to make selections the result will be disastrous. The supply of efficient administrators is extremely limited at best. Too much emphasis cannot be laid upon the imperative necessity of highly trained administrators and the most highly trained clerical force from which to develop such administrators.

Those familiar with the Federal service at Washington know that the service is now hampered by the retention of incompetents whose removal is rendered difficult by influences which are incompatible with the efficiency of the service. Preferences and exemptions increasingly clog the departments with persons who, no matter how inefficient are difficult to remove and whose retention tends to destroy the discipline of the service.

Effect of Meager Pay on Morale

In the questionnaire sent out, a request was made for information "as to present morale of the service reported upon." In 13 cases conditions were reported as satisfactory, in several others no comment was made, but that there is a spirit of general unrest and dissatisfaction is well evidenced by the following 44 quotations, which represent 44 per cent of the total responses:

This whole matter is of vital importance to engineers. Many well qualified college graduates today are receiving far less for their services than mechanics without any mental training, and this condition is, of course, economically unsound.

There is obviously a discrepancy here which should be removed either by raising the salaries of engineers and other professional men, or reducing the salaries of laborers, mechanics and artisans and thereby reducing the cost of living.

The consensus of opinion seems to be that there will be no great reduction in the cost of living for some time to come, if ever, which leaves us only the alternative of increasing the salaries of professional men in proportion to the increase in the cost of living.

While work is not unsatisfactory, efficiency is impaired by discontent due to insufficient compensation.

ANALYSIS OF RETURNS SHOWN BY 35 QUESTIONNAIRES RELATIVE TO STATE SERVICE IN 40 STATES

Character of Service	Position	Number of Persons Now in Position	Age—Years* Range	Age—Years* Average	Recommended Compensation per Annum * Dollars — Range — Maximum	Range — Minimum	Average — Maximum‡	Average — Minimum‡	Average Compensation per Annum * July 1, 1915	July 1, 1919 — Maximum‡	July 1, 1919 — Minimum‡	July 1, 1919 — Average	July 1, 1919 — Recommended	* Per Cent. Increase in Compensation Over July 1, 1915 Actual on July 1, 1919	Recommended
Professional	Consulting Engr.	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Professional	Chief Engr.	31	30–70	41	3,600–25,000	3,600–10,000	8,104	6,144	3,743	4,481	4,481	4,481	7,124	20	90
Professional	Deputy Chief Engr.	19	30–51	38	2,400–10,000	2,400– 5,000	5,310	3,810	3,352	3,278	3,114	3,616†	4,477	8	34
Professional	Engineer	80	30–50	37	2,700–10,000	2,700– 5,000	4,750	3,815	2,530	3,124	2,980	3,019	3,934	19	56
Professional	Senior Ass't Engr.	111	30–50	32	2,000– 6,000	1,800– 5,000	3,781	3,312	1,981	2,529	2,351	2,429	3,222†	23	63
Professional	Assistant Engr.	396	27–42	33	1,750– 5,000	1,500– 4,200	3,126	2,488	1,657	2,213	1,921	2,140	2,758	29	66
Professional	Junior Ass't Engr.	529	21–36	27	1,500– 4,000	1,200– 2,400	2,395	1,853	1,130	1,777	1,517	1,595	2,100	41	86
Professional	Staff	1,166	21–70	..	...	...	...	...	1,590	...	...	2,070	2,730	30	72
Sub-Prof.	Senior Draftsman	29	25–40	31	1,500– 3,600	1,500– 3,600	2,493	2,250	1,508	1,891	1,851	1,868	2,327	24	54
Sub-Prof.	Draftsman	141	22–50	28	1,200– 2,400	1,200– 2,400	2,028	1,799	1,224	1,676	1,488	1,653	1,944	35	59
Sub-Prof.	Junior Draftsman	110	20–25	22	1,000– 2,000	900– 1,800	1,514	1,271	924	1,310	1,122	1,227	1,394	33	51
Sub-Prof.	Chief Instr'man	61	24–40	27	1,500– 2,400	1,500– 2,400	2,086	1,829	1,297	1,683	1,483	1,611	1,915	24	48
Sub-Prof.	Instrumentman	193	22–30	23	1,620– 2,100	1,200– 1,800	1,902	1,567	1,243	1,410	1,300	1,498†	1,773	21	43
Sub-Prof.	Rodman	522	18–26	20	800– 1,800	780– 1,200	1,291	1,061	791	1,055	951	1,057†	1,148	34	45
Sub-Prof.	Staff	1,056	18–50	..	...	...	...	...	995	...	...	1,290	1,470	30	48
Entire service		2,222	18–70	..	...	...	...	...	1,310	...	...	1,700	2,130	30	63

* Based on such returns as are complete. ‡ Arithmetrical mean. † Apparent discrepancy due to incomplete data and use of averages weighted according to number of persons occupying position.

Dec. 15, 1919.

Morale good, with exception of unrest in the way of insufficient salaries; interest of the men in their work has a great deal to do with the morale.

Morale good, except for wages. Have lost number of best men recently due to inflexibility of salary question.

Not up to standard on account of insufficient compensation.

While work is not unsatisfactory, efficiency is impaired by discontent due to insufficient compensation.

Some dissatisfaction because of existing inadequate salaries and the failure of the city authorities to increase same to reasonable figures.

Lowered considerably due to the fact that the present salaries are entirely inadequate to meet the present high cost of living.

Morale is very good but there is much restlessness because of the high prices and lack of appreciation of value of work.

Men are dissatisfied with present compensation. Suitable new men cannot be obtained at present salaries to fill vacancies caused by men leaving to accept better paying positions.

Dissatisfied with the service, due to the fact that they are unable to maintain previous standards of living on account of high costs. No advance in engineering salaries comparable to general advance in wages. Unable to fill present vacancies.

Very poor.

Morale very poor at this time. I have just lost by resignation three of my highest paid and valuable engineers.

While there have been salary increases in the past three years averaging about 40 per cent, there is a feeling of dissatisfaction among the members of the force over the present salaries, many thinking they are not comparable with similar positions in private corporations.

Increased compensation for practically all engineers in this department, excepting the head, has already been secured through effort of state, city and county combined.

The present morale is good, although the matter of increased compensation seems to be a popular one to discuss.

I have promise of 43 per cent raise for engineers at head of sub-departments next year and the men are feeling very good about it.

Men generally feel that their compensation is insufficient and inadequate under present costs of commodities.

Low on account of heavy work, low salaries and small forces, due to Legislature failing to take care of compensation in proper manner.

Constant growl about salaries.

Fair—probably better than for most engineering organizations in municipal service in this vicinity, as it has been possible to make several increases in salary since rise in living cost started.

Our organization is in a condition of unrest and change owing to small appropriation.

We have excellent service, but there is a feeling among these engineers that the service is not properly paid for.

The present morale of the service reported on is very gratifying to me for the compensation that is being paid. A substantial increase in wage would no doubt insure better efficiency.

Impossible to hold first-class men at these rates. Morale is generally good.

The chief engineer has recently resigned because of inadequate compensation. The new chief appointed in his place is expecting to resign shortly for the same reason. The present assistant engineer expects to work only a short time and that merely for the experience gained.

Morale would be improved if adequate salaries were allowed.

Practically all men are clamoring for more pay, but as our budget was fixed while the country was at war we are unable to secure the additional funds necessary to raise salaries further.

All want more money. Dissatisfied on account of low pay.

Our organization is in a condition of unrest and change owing to small appropriation.

Loyal enough generally, but dissatisfied with pay, and accept better offers readily. Difficult to fill their places at same rates.

Excellent, but all employees desire increase in compensation over that already granted. New men cannot be obtained at previous salaries.

Dissatisfied with present compensation.

Force depleted. Employees leaving to take positions at greater compensation. Men remaining uneasy and dissatisfied.

I thoroughly agree with the men in New York City who demand a flat raise of $500 yearly in all classes of the service.

There is a decided spirit of unrest and dissatisfaction, due to the fact that engineering salaries have not been increased in proportion to the advance in the cost of living, and to salaries and wages paid to non-professional men and skilled labor.

Rate of pay tends to drive men active and self-reliant younger men out of this service—lowering general average.

Majority of men feel they are underpaid.

Lack of consideration for services rendered has discouraged the force.

A general increase of $150 to $400, effective Sept. 16, 1919, has improved the morale of the force, which was affected both by a general reduction of force and the economic situation.

Increasing restlessness on the part of the entire force due to lack of proper salary increases to meet growing expenses.

While men for the most part do their work satisfactorily, there is a general feeling of unrest and discouragement as a result of what they consider failure to recognize their efforts.

Unsatisfactory and strongly tending to disintegrate the force.

ANALYSIS OF RETURNS SHOWN BY 66 QUESTIONNAIRES RELATIVE TO MUNICIPAL SERVICE IN 27 CITIES

Character of Service	Position	Number of Persons Now in Position	Age—Years* Range	Age—Years* Average	Recommended Compensation per Annum * Dollars — Range — Maximum	Recommended Compensation per Annum * Dollars — Range — Minimum	Recommended Compensation per Annum * Dollars — Average — Maximum‡	Recommended Compensation per Annum * Dollars — Average — Minimum‡	Average Compensation per Annum * July 1, 1915	Average Compensation per Annum * July 1, 1919 — Maximum‡	Average Compensation per Annum * July 1, 1919 — Minimum‡	Average Compensation per Annum * July 1, 1919 — Average	Recommended	* Per Cent. Increase in Compensation Over July 1, 1915 — Actual on July 1, 1919	* Per Cent. Increase in Compensation Over July 1, 1915 — Recommended
Professional	Consulting Engr.	8	39–70	55	7,200–15,000	5,000–12,000	9,130	7,560	5,457	6,897	6,897	6,410†	8,550	18	57
Professional	Chief Engr.	64	30–64	44	3,000–20,000	3,000–20,000	7,860	7,245	5,424	5,500	5,460	5,467	7,465	1	38
Professional	Deputy Chief Engr.	19	35–60	48	3,000–12,000	3,000– 9,000	6,062	5,754	4,624	4,625	4,301	4,901†	6,320†	6	37
Professional	Engineer	165	30–68	46	2,700–10,000	2,400– 6,600	4,944	4,176	3,446	3,815	3,208	3,679	4,749	7	38
Professional	Senior Ass't Engr.	265	30–64	41	2,400– 5,500	2,100– 5,500	3,575	3,020	2,428	2,734	2,329	2,616	3,293	8	36
Professional	Assistant Engr.	505	27–53	40	1,800– 4,200	1,500– 3,500	2,875	2,430	1,902	2,287	1,972	1,999	2,613	5	37
Professional	Junior Ass't Engr.	452	25–45	34	1,500– 3,000	1,200– 2,700	2,135	1,793	1,415	1,770	1,469	1,548	1,812	9	28
Professional	Staff	1,478	25–70	..	.....	.....	.....	.....	2,230	.....	.....	2,370	3,020	6.5	36
Sub-Prof.	Senior Draftsman	100	28–53	42	1,800– 4,000	1,500– 3,000	2,482	2,275	1,777	1,994	1,942	1,982	2,356	12	33
Sub-Prof.	Draftsman	442	25–65	35	1,500– 3,000	1,200– 2,500	2,085	1,817	1,395	1,673	1,493	1,626	2,008	17	44
Sub-Prof.	Junior Draftsman	118	21–48	26	1,200– 2,200	1,080– 1,800	1,629	1,390	1,055	1,345	1,183	1,205	1,439	14	36
Sub-Prof.	Chief Instr'man	88	28–53	40	1,500– 3,000	1,500– 2,400	2,203	1,941	1,454	1,824	1,681	1,700	2,162	17	49
Sub-Prof.	Instrumentman	448	22–52	38	1,200– 2,500	1,200– 2,100	1,804	1,596	1,174	1,539	1,341	1,426	1,737	21	48
Sub-Prof.	Rodman	643	17–52	32	900– 1,800	780– 1,800	1,406	1,242	868	1,150	1,016	1,056	1,352	22	56
Sub-Prof.	Staff	1,839	17–65	..	.....	.....	.....	.....	1,160	.....	.....	1,370	1,700	18.5	47
Entire service		3,317	17–70	..	.....	.....	.....	.....	1,640	.....	.....	1,820	2,290	11	40

* Based on such returns as are complete. ‡ Arithmetical mean. † Apparent discrepancy due to incomplete data and use of averages weighted according to number of persons occupying position.

Dec. 15, 1919

A request was also made in the questionnaire for "suggestions as to the course to be pursued in order to insure recognition of the results of this investigation," in reply to which 32 have been offered, as follows:

Newspaper publicity, articles in magazines, such as *The American Magazine* and *Saturday Evening Post*.

Recommend schedules and give plenty of publicity. It is considered unethical for architects to accept a commission for less than the minimum schedule fixed by the American Institute of Architects. Engineers should not accept less than the minimum schedule fixed by the Engineering Council.

An educational campaign with comparison of salaries paid bricklayers, plumbers, switchmen, brakemen, etc., and those paid the engineering profession, which requires a university education and constant study to keep pace with modern construction.

Get in behind the employing engineers, they are responsible more than any one else for low salaries.

Very difficult to get local authorities to notice general investigation figures.

A copy of the findings of your committee should be mailed to the Mayors of the various cities.

Recommendations should be sent to mayor and municipal council urging they take action.

Wide publicity and assistance from local engineering associations.

Send analysis of returns and recommendations to all those making reports, to the officers and boards having power to fix salaries, to civil service commissions, and to technical journals.

Amend the labor law to include Civil Service employees.

The attention of proper officials and boards should be persistently called to the low scale of salaries now in force.

I believe a certain amount of publicity with the various organizations interested in the city government, would indicate the importance of engineering investigation as compared with accountants and clerks, in advising executive action.

A just and concise statement of facts to a just and capable authority.

To actively co-operate with the various engineering societies in their efforts to secure, by legislation and otherwise, a greater recognition of the services of the engineer.

Prompt action, together with a definite recommendation for classification and salaries, is necessary to accomplish results. The report, in the case of cities, should be sent to the Mayor and legislative body of each city, uring its adoption. Where necessary, and when requested by the municipal engineering staff, the committee should appear before the city officials to explain and advocate the adoption of both salaries and classification.

Impress upon the mayor and members of council, the necessity of proper classification and salaries if the city is to secure and maintain a competent organization. Consideration of annual budget is now before the council.

Publicity and circulation of the results of the investigation among members of boards having authority to prepare the budgets and fix compensation in the various municipalities.

Presentation of suggestive schedule to city administration, urging conformity; also use of follow-up methods to secure results.

A published and well-distributed report of the investigation of your Council together with positive recommendations and the reasons therefor.

Join American Federation of Labor, or, in any event, organize for a complete Union of Engineers.

Upon completion of this work, I would respectfully suggest that impressive letters should be directed to the heads of the municipality, county or state as the case may be.

Make tabulation of recommended scales of various classes of cities. Send tabulation with a local scale comparison to officials of various municipalities.

The methods used by the American Association of Engineers.

(1) Closer union between technical men; (2) licensing of engineers; (3) publicity.

The maintenance of high professional standards among engineers. The passage of laws regulating the practice of engineering. Educate the public to appreciate first-class engineering service.

By producing the goods and by employers raising salary of engineers of merit. Picking good men and paying them much above the average.

Get some legislators with business sense.

The salaries shown under "Recommended" are those adopted in this department on Nov. 1, 1919. My recommendation is a further increase of 15 per cent at an early date.

Appoint committees to present proposition to state legislatures.

Wide publicity, organization, license and closer touch with legislative bodies.

Combine with all engineering bodies in the U. S., and then work as a unit on all public departments—private employers will follow.

To raise salaries of employees of state engineer's office requires the approval of the state legislature to an increased appropriation bill.

Committee's Recommended Salary Scale

The work of the committee has now reached the stage of considering the scale of compensation which may be set up for the various grades. From the data obtained from the questionnaire, it would appear that the compensation recommended by the heads of the various services represents, in the cases where information is given, about 5 per cent of the value of the work supervised. The committee is investigating the percentage of cost of engineering work on large enterprises of various kinds under both public and private direction. It is hopeful that through the accumulation of data of this character a valuable foundation may be established on which to base engineering compensation.

The investigation made by the Federal Government Section of the committee as to compensation was largely confined to a compact territory where all the services affected could be readily reached. It has, therefore, naturally advanced at a much more rapid pace than was practicable in the state and municipal services. The Federal Section has tentatively offered a salary schedule built up on what is known as the "Macy Scale," and also a plan for advancing men in the various grades, which were described in the report of the main committee (*Engineering News-Record*, Jan. 15). Both of these clearly have much merit, and it would seem desirable to submit them tentatively to the representatives of the state and municipal services with a view of obtaining such criticism as might be offered, and with the suggestion that they be put into effect where practicable pending the working out of final conclusions.

Comparing the combined schedule of compensation for state and municipal service as of July 1, 1915, with the present compensation, with the compensation recommended by the heads of the various services from which reports have been received, and with the compensation now tentatively suggested by the committee, it will be found that the changes would be as follows:

Total increase in compensation granted since July 1, 1915, 18 per cent.

Total increase in compensation now recommended by service heads as compared with compensation of July 1, 1915, 48 per cent.

Total increase in compensation under schedule tentatively suggested by committee as compared with compensation of July 1, 1915, 83 per cent.

It will also be found that the aggregate increase over compensation as of July 1, 1919, as recommended by the heads of the various services would be 26 per cent, while that which would result under the tentative schedule would be about 56 per cent.

The money value of the increases in salary recommended by the service heads over the compensation of July 1, 1919, is about $2,500,000, while an additional amount of about $3,000,000 would be required if the tentative salary schedule of the committee was put into effect.

In this connection it should be noted that through the provision of adequate compensation and the consequent restoration of morale, efficiency would be increased to such an extent as to introduce a real economy. This would result from a decrease in force and from the securing of better results from the expenditures under engineering supervision.

To conform with the reasonable requirements of state, county and municipal service, it would probably be undesirable to fix either a minimum or maximum salary for the highest grade, and it may be found advisable to place the maximum for other grades substantially higher than the minimum for the next higher grade. It would also seem desirable to set up a condition that promotion should be withheld in the case of men who are shown to be temperamentally or professionally unsuited or least adapted to the service, thus encouraging the abler men to remain and removing an incentive to others to become permanent fixtures.

The State and Municipal Section of the committee is made up as follows: Arthur S. Tuttle, Deputy Chief Engineer, Board of Estimate and Apportionment, New York City; F. W. Cappelen, City Engineer Minneapolis; M. M. O'Shaughnessy, City Engineer, San Francisco.

Rotary Snowplows Clear Streets in Canadian Cities

Machine Hauled by Horses Has Gasoline Engine To Drive Cutters—More Economical and Rapid Than Hand Labor

A POWER-OPERATED rotary snowplow hauled by horses is a new development in machinery equipment for cities where removal of snow is a serious and annual problem. Such a machine is being used on streets, suburban roads and sidewalks in some Canadian cities with satisfactory results as to both efficiency and economy. The general design is shown in Fig. 1, while Fig. 2 is a rear view of the machine in use. In Fig. 3, the plow is shown working on a sidewalk in a residential district. Its weight is about three tons and its length is 18 ft. over all.

Swiveling sleds carry a steel frame 14½ ft. long, the team being hitched to the forward sled and the rear sled being steered by means of a handwheel. Upon the frame is mounted a 60-hp. gasoline engine, having its shaft placed longitudinally and geared to a cross shaft at the rear. This shaft has a sprocket wheel for chain drive to a shaft hung below the frame and carrying two rotary cutters. The cutter shaft can be raised and lowered in order to vary the depth of cut as may be required. The four-bladed cutters mounted on this shaft are 22 in. in diameter, 22 in. wide and 22 in. apart, a wedge-shaped plow being placed in front of the space between the two cutters so as to deliver the snow to them. Thus the total width of cut is 5½ ft. The nose plow is carried by the frame of the cutter shaft and is thus raised and lowered with it.

The cutters are driven at a speed of 500 r.p.m. and

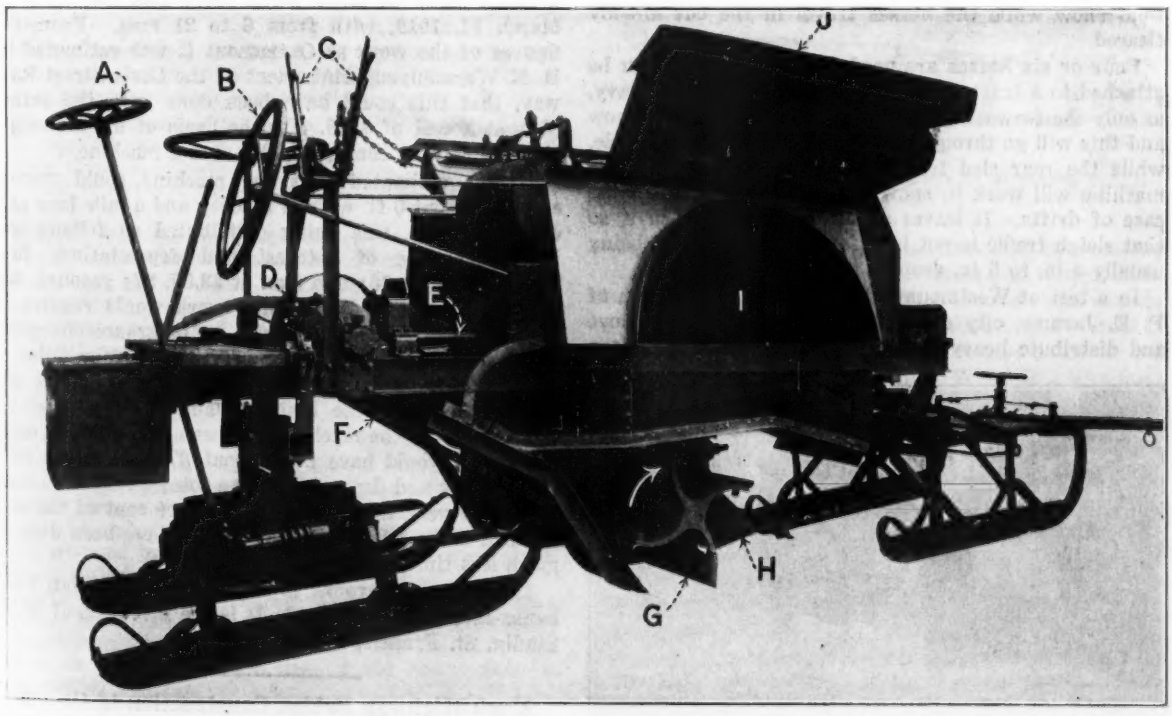


FIG. 1. ROTARY PLOW FOR STREETS AND ROADS IS MOUNTED ON SLEDS AND HAULED BY TEAMS
A—Handwheel for steering rear sled; B—Handwheel for regulating height of cutter shaft; C—Engine levers; D—Sprocket wheel; E—Engine shaft; F—Driving chain; G—22-in. cutter; H—Nose of wedge plow; I—Discharge opening; J—Snow deflector.

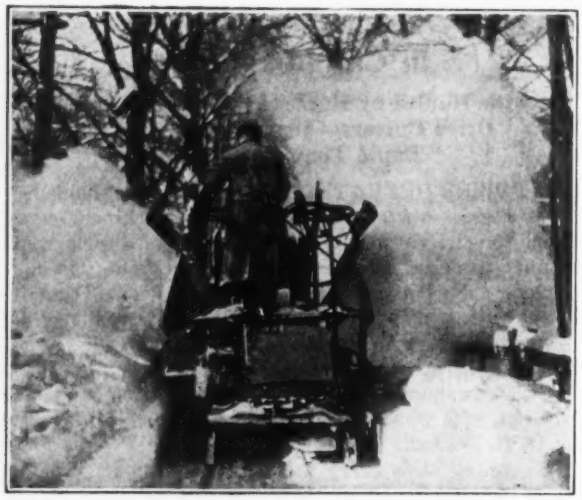


FIG. 2. REAR VIEW OF ROTARY PLOW MAKING A CUT

discharge the snow as a finely divided dust through deflecting hoods on one or both sides of the machine, the maximum width over these being 6½ ft. The deflectors are adjustable, to enable the snow to be delivered at about 3 or 4 ft. from the machine in streets or thrown to a distance of 40 to 50 ft. on suburban roads. Thus no snow is thrown against buildings or windows along the streets. In the suburban districts the residences are set back from the street, so that the snow from the roadway and sidewalks is thrown over the lawns. No objection is raised to this, as the snow is spread and does not form banks. In widening the first 5½-ft. cut, or in operating along street railway tracks, the machine is offset so as to be crowded into the solid snow while the horses travel in the cut already cleared.

Four or six horses are used, but the machine can be attached to a tractor or truck. The draft is not heavy, as only the forward sled has to break through the snow and this will go through a 36-in. depth without trouble, while the rear sled travels in the cleared path. The machine will work in snow up to 6 ft. deep, as in the case of drifts. It leaves a bed of snow beneath it so that sleigh traffic is not interfered with, this bed being usually 4 in. to 6 in. deep on municipal work.

In a test at Westmount, Que., under the direction of P. E. Jarman, city engineer, the work was to remove and distribute heavy compacted banks which had been formed by pressing back the snow from the middle of the roadway with the blade of a snow grader. Mr. Jarman gives the cost as $35.70 per 1,000 cu.yd. This included operating charges for four horses, two drivers, a mechanic, gasoline, oil, grease and repairs; also charges for depreciation, interest and insurance. Removal by hand shoveling would have cost $53.80 per 1,000 cu.yd. Further, Mr. Jarman points out that the men would have piled the snow in high banks while the machine spread it in a thin layer. As a result of the test and other experience the city purchased one of the rotary plows.

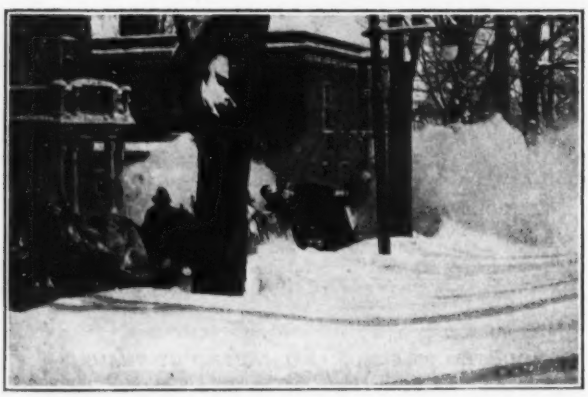


FIG. 3. SIDEWALKS ARE CLEARED BY ROTARY PLOW

At Outremont, Que., which also has a machine, careful study of the cost was made by J. Duchastel, city engineer, and E. Lacroix, assistant city engineer. In three days (23 working hours) the machine cleared a 10-ft. path in snow 21 in. deep for a distance of 6,775 ft. at a cost of 7.2c. per lin.yd., or 3.7c. per cu.yd. This included fixed charges of $14 per day for repairs, 7 per cent interest and 10 per cent depreciation; also gasoline, operator, two city teams and the cost of a grader and single plow used in connection with the work. In comparison with this was the removal of snow by hand shoveling into wagons on sleighs, on a stretch of 950 ft. of the same road, with the same depth and width of cut, at a cost of 23.7c. per lin.yd., or 12c. per cu.yd. This was done in a 10-hour day by 14 men at 25c. per hour, a foreman at 35c., a city double team at 65c., three hired double teams at 60c. and four hired single teams at 30c. Sidewalks made impassable by drifts were cleared by the machine at about 50 per cent of the cost of hand shoveling. Here, as at Westmount, the advantage was noted of distributing the snow evenly in a thin layer instead of forming banks.

Hand shoveling on a mile of road at Levis, Que., cost $1,979 during 35 days' work from Dec. 26, 1918, to March 12, 1919, with from 6 to 21 men. From the figures of the work at Outremont it was estimated by H. E. Weyman, superintendent of the Levis Street Railway, that this could have been done with the rotary plow at a cost of $396. On the basis of his investigation the railway company purchased a machine.

It was estimated that the machine could remove snow for a cut 5 ft. wide, 4 ft. deep and a mile long at a cost of $20.79, this being distributed as follows and being exclusive of interest and depreciation: four horses at $1.50, $6; two men at $3.50, $7; gasoline, $6; oil, $1; insurance, 79c. Hand work would require 24 men at $3 per day, which with an insurance charge of $8.13 would make a total of $80.13. On four miles of road at Levis, where the snow was shoveled back and not carted away, the cost of hand work last winter was $3,000. If the machine had been available the operating cost would have been about $750. Adding $810 for interest and depreciation the total would have been $1,560, or very little more than 50 per cent of the cost of hand labor, while the work would have been done in much less time.

This rotary snowplow is built by the Canadian Fairbanks-Morse Co., Montreal. It is the invention of W. L. Stadig, St. Francis, Me.

Much Highway Bridge Construction in Oregon

Over 150 bridges are under construction, or advertised for letting, by the Oregon State Highway Commission, at a total cost of about $1,500,000.

Resolutions of Pittsburgh Engineers On Bridge Design by Architects

ON Jan. 20, 1920, the Engineers' Society of Western Pennsylvania took formal action to express its disapproval of the county commissioners' course in entrusting the design of important new bridges at Pittsburgh to architects. The concrete case at issue is that of the new Allegheny River bridges at Sixteenth and Forty-third Sts., discussed in *Engineering News-Record* of Oct. 9, 1919, p. 686. Some weeks ago the society referred the case of these bridges to a special committee headed by Morris Knowles, and it was the report of this committee that came before the meeting of Jan. 20. The following resolutions, proposed by the committee, were adopted by the Society:

Whereas, in the design and construction of bridges and similar structures safety to human life, economy in the expenditure of public funds and the traffic needs of the community require that the structural design, inspection of construction and erection and arrangement and development of approaches and street grades should be placed in the hands of competent and experienced engineers, especially skilled and trained for these classes of work; and

Whereas, to secure harmonious and artistic results the æsthetic treatment and decoration of such structures should be entrusted to skilled architects; and

Whereas, the best interests of the community are served by the co-operation on such work of engineers and architects, both responsible to the public officials in charge of the execution thereof; and

Whereas, the county commissioners of Allegheny County have retained architects to design and supervise construction of certain bridges; and

Whereas; although such architects have employed engineers to assist them in the structural design of such bridges, these engineers are not responsible to the county commissioners except through the architects by whom they are employed; and

Whereas, the county commissioners have in their employ as County Engineer a competent and experienced engineer with an organization skilled and trained in the consideration of bridges and their appurtenances; and

Whereas, Section 2 of the Act of May 8, 1919 (P. L. No. 108), requires that "The county engineer . . . shall prepare plans, specifications and estimates of all engineering work undertaken by such county, . . .") Therefore, be it

Resolved, that the Engineers' Society of Western Pennsylvania earnestly recommends to the county commissioners

First, that on all future structures of this kind, the structural design, the inspection of construction and erection and the arrangement and development of approaches and street grades be recognized, in accordance with the law, as the function of the County Engineer or of other engineers retained as his advisors, and that the æsthetic treatment and decoration be entrusted to skilled architects retained as consultants to the County Engineer; and

Second, that in cases where architects have already been retained, the county commissioners require the County Engineer, or else a competent consulting engineer retained as his advisor, to pass upon the safety and economy of all plans prepared by the engineers employed by such architects. And be it further

Resolved, that the Pittsburgh Chapter of the American Institute of Architects be invited to join with the society in impressing upon the commissioners and the public the importance of proper co-operation of the two professions on future work of this character.

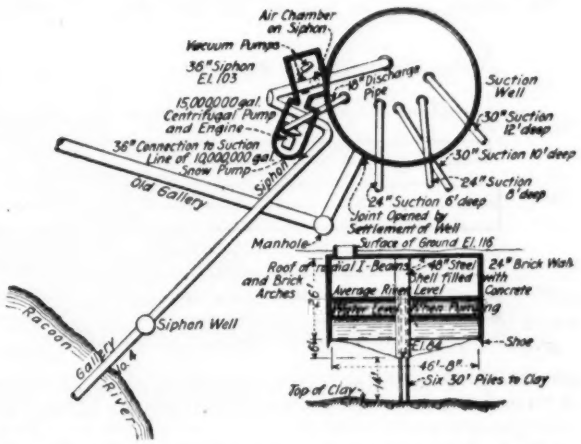
W. G. WILKINS,
SAMUEL E. DUFF,
JOHN A. HUNTER,
MORRIS KNOWLES, Chairman.

Suction Well Settlement Curtails Des Moines Water Supply

Undermined Well and Pits and Opening of Siphon Cuts Supply for Six Days—Emergency Repairs Are Described

INTERRUPTION of the water supply of Des Moines, Iowa, for six days was caused recently by the settlement of a portion of the wall of the suction well at the pumping station. This well (see sketch) was sunk in 1882, its brick lining wall, resting on a cast-iron shoe, being sunk as a caisson through sand and gravel. On Jan. 3, 1920, a portion of the brick wall sank about a foot, opening a joint between it and a 4 x 5-ft. timbered collecting gallery. The wall adjacent to the gallery entrance is pierced by several suction pipes and did not settle. As clay is several feet below the cutting edge and there is no floor, sand and gravel could work under the shoe without difficulty, thus undermining the wall.

Infiltration galleries in a bed of clay and gravel along the Raccoon River valley form the source of the water supply. When the river is low the depth of



PLAN AND SECTION OF DES MOINES SUCTION WELL AND PITS

water over the galleries may be increased by pumping from the deeper parts of the channel, as noted later. The night consumption is at an approximate rate of 6,000,000 gal. The day rate is from 13,000,000 to 14,000,000 gal., and to meet this a second pump is put in service early in the morning. When this was done on Jan. 3, the second pump started and then stopped suddenly, but the 10,000,000-gal. horizontal compound pump already in operation kept going, although it labored considerably.

Sand poured through the gap, filling the well above the suction openings of all the pumps except the one of 10,000,000-gal. capacity and burying the end of a 36-in. siphon, 600 ft. long, delivering water from another set of infiltration galleries, which yield the main supply to the well. The settlement opened the joints in the siphon line and disturbed the siphon vacuum pumps located in a pit adjacent to the suction well. The lining of this pit settled and caved. Another adjacent pit, housing a 15,000,000-gal. low-lift steam-driven centrifugal pump, was also undermined and settled badly, cracking the walls and floor. As a result

of the accident, the water supply was reduced to a rate of 8,000,000 gal. daily, or about 57 per cent of the maximum. The higher portions of the city were without water except for a few hours at night.

The cause of the accident has not been determined definitely. When the leak in the siphon is located this will have an important bearing on the situation. One theory is that the 36-in. siphon lost its prime owing to a leak and that then the surge in the gallery due to starting the second pump without the full water supply coming into the well permitted the water in the suction well to be drawn down to an unusual depth so that the pressure of ground water, then at a considerably higher elevation outside of the well, forced a quantity of sand under the shoe and up into the well. If this was the case, the undermining may have been excessive on the side opposite the gallery, causing this side to sink and thereby loosen the joint between the end of the gallery structure and the wall of the well. An oak wedge from this joint was carried through with the sand and was found to be in an excellent state of preservation.

To repair the break, solid wood sheeting was driven to the gallery, 24 ft. below ground, and the gap between the gallery and the wall of the well was thus closed to exclude the further flow of sand into the well. The adjacent pits and machinery were shored up. The siphon was slung from timbers and recalked. The air pumps were removed to a safe distance and a blower of 50-cu.ft. capacity was installed to assist in getting a vacuum in the siphon.

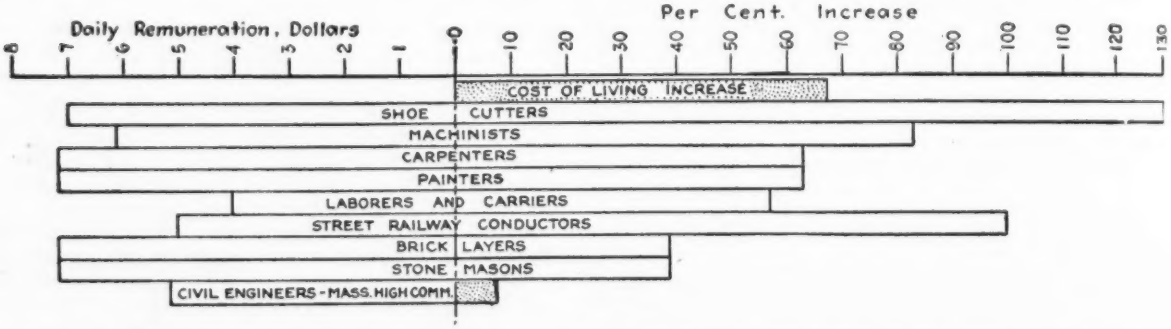
By Monday night, Jan. 5, the 10,000,000-gal. pump had sucked most of the gravel from the well and deposited it in the mains. On Tuesday night the siphon was started and on Wednesday it was possible to deliver water at a rate of 10,000,000 gal. daily, running the 10,000,000-gal. pump at full capacity. A second pump was put in service and a low stage in the well to help out the siphon was maintained all day. A 7-in. vacuum was all that could be maintained in the siphon, however, because all of the joints could not be reached for calking. A 10-in. vacuum is required for full operation. On Wednesday night a large duplex pump was added to the air equipment and removed all air that leaked into the line. It was then possible to fill the distribution system during the night, but a large residence area was unwatered each day.

Normal service was resumed on Sunday, Jan. 11, sufficient pump capacity having been installed temporarily to overcome the leak in the siphon and the ground-water level on the gallery system having been increased in the manner already mentioned, by the operation of the flooding pumps on the gallery. The work of locating the leak in the siphon was then progressing, but with the probability of requiring several days, as this line is at a depth of from 8 to 30 ft.

Damages will amount to several thousand dollars. The emergency work was done under the direction of A. T. Luce, superintendent of the Water Department. The construction of a new pumping station, planned by Alvord & Burdick, will be hastened by the accident and the old station, which it was intended to abandon in two or three years, will be repaired temporarily to give service until the new equipment can be placed.

Salaries of Engineers in the Service of the Massachusetts Highway Commission

AT THE meeting of the Boston Society of Civil Engineers on Oct. 29, one of the engineers of the Massachusetts Highway Commission presented the accompanying diagram, which was prepared to back up a recent appeal for an increase in compensation made by the engineers of the Massachusetts Highway Commission. The


Daily Remuneration, Dollars
Per Cent. Increase
8 7 6 5 4 3 2 1 0 10 20 30 40 50 60 70 80 90 100 110 120 130
COST OF LIVING INCREASE
SHOE CUTTERS
MACHINISTS
CARPENTERS
PAINTERS
LABORERS AND CARRIERS
STREET RAILWAY CONDUCTORS
BRICK LAYERS
STONE MASONS
CIVIL ENGINEERS - MASS. HIGH COMM.

FIVE YEARS INCREASE IN COMPENSATION OF ENGINEERS OF MASSACHUSETTS HIGHWAY COMMISSION COMPARED WITH INCREASE OF COST OF LIVING AND WAGE INCREASES OF ARTISANS AND LABORERS

figures from which the diagram was plotted were obtained from the Massachusetts Bureau of Statistics and from the payrolls and records of the Massachusetts Highway Commission. Recent data published by the United States Bureau of Labor show a greater increase in the cost of living than that stated in the diagram, the Bureau's figures for July, 1919, at Boston, being about 73%. The figures for the daily earnings of artisans and laborers are based on an 8-hour day, although many of these workmen work overtime and are paid 50% additional for such overtime. The average salary of the civil engineers on the staff of the Massachusetts Highway Commission who had had three years' or more experience was, in July, 1914, $118 per month; July, 1919, it was $126.06. These engineers averaged 13½ years' experience in the profession.

Airplane for Mapping Forests

F. A. Elliott, Oregon state forester, has recommended that a complete airplane observation squadron, including photographic and radio sections, should be provided for that state this year for use in fire patrol and mapping service. Planes have been used this year with success in locating fires, and it is planned to continue the work next year.

Wood Piles Coated With Concrete Applied by Cement-Gun

Porto Rico Pre-coated Piles in Good Shape Six Years After Driving—Western Railway Applies Gunite to Trestle

CONCRETE applied with the cement-gun, colloquially known as gunite, has been used in a number of places to protect wooden piles from the ravages of marine woodborers. Two such cases of different significance have just been reported. One is in Porto Rico, where piles coated with gunite before driving have now been in satisfactory service for six years; the other is on a Pacific Coast interburban railway, where the rapid destruction of an existing trestle has been stopped by coating the piles near their base.

The Porto Rico case is reported by the engineer of the Harbor Board of San Juan, through a local representative of the United States Corps of Engineers. This engineer writes "I have carefully inspected all of the concrete-coated timber piles which were placed in the San Juan bulkhead during the years 1913 and 1914 and find them to be in excellent condition as far as can be determined by external observation. The water was sufficiently clear to make examinations to a depth of 10 ft. and most of the piles were embedded in riprap at about this distance below the water. There is no indication that marine borers have attacked these piles.

Precoated Piles at Porto Rico

"In the construction of the San Juan Bulkhead, which is 2,453 ft. long, 1,016 coated piles were used and 327 concrete piles, all about 50 ft. in length. The reinforcement was a wire mesh and the mortar was placed by means of the cement-gun. In the later part of the work concrete piles were used in place of cement-coated timber piles for the reason that 184 coated piles were rejected on account of defects in the coating before driving and 180 additional coated piles had to be repaired after driving because of cracks or other defects which occurred during driving. Repairs had to be made by a diver at a large expense and were not considered satisfactory. Concrete piles were substituted at an additional cost of $20 each."

WOOD PILE WITH CONCRETE BASE PLACED OVER SECTION EATEN BY LIMMORIA

APPLYING THE CONCRETE WITH CEMENT-GUN TO PILES EATEN BY LIMMORIA

The piles were Southern pine, not first-class, some with much sap and crooked, so that about half the number, probably 200, were condemned. The condemned lot, most of them coated, lay on the ground for many months, and those exposed to the weather have considerably decayed.

The specifications called for a 2½-in. covering, but it was found that about 75 per cent of the piles, which were left about 30 days to cure, showed fine cracks on the surface of the cement, undoubtedly caused by contraction. These cracks did not in many cases penetrate the whole of the coating, as verified by cutting carefully one pile in two with a saw. It was also assumed that the specified thickness of the coating could be reduced with advantage to 2 in., which was done afterward, the air cranks appearing thereafter to be less prominent.

The piles were driven about 2 ft. into hard bottom and were carefully inspected before being driven. Apprehending, however, that the driving might have augmented the sun cracks so as to open them further and deeper, each pile after being driven was subsequently inspected by a diver after about one-half of the lot had been driven, and if any large cracks were discovered a wooden form was placed around the particular spot and fresh concrete poured into it, in the water. This was used in about 200 cases. Generally the coating appeared to have stood the vibrations and shocks of the driving better than was expected, as evidenced in one case where a pile was drivin by 118 blows, fall of hammer about 15 ft., without any deleterious results being visible afterward.

The contractor who built the bulkhead in 1913 drove twelve similarly coated piles for a molasses company at San Juan. An examination made of them recently shows that the coating is still well preserved and adhering to the pile, but the exposed wooden heads have decayed so that they had to be covered with concrete.

The information regarding the work on the trestle of the Pacific Northwest Traction Co., is from John Hickock, Superintendent of the Railway Department. The Northern Division of this interurban system operating between Bellingham, Wash., and Skagit County points, has approximately 4½ miles of trestle which was driven with heavy cedar piling in 1911. This trestle is over salt-water tide flats, the piles being submerged a greater part of the time. After the piles had been driven less than two years, it was noticed that limmoria had begun cutting away the piles immediately above the ground, as shown in one of the views. In 1915, or when the trestle was less than four years old, this action had become so great that the piles were fully 25 per cent cut off.

In order to put a stop to this destruction concrete bases were put around the piles. These bases extended

APPEARANCE OF THE GUNITED TIMBER PILE AT BELLINGHAM, WASH.

6 in. below the surface of the ground and 18 in. above. They were reinforced with four spirals of No. 12 gage iron wire, held in place by nails driven at sufficiently close intervals to place the reinforcement near the center of the material. The bases were 4 in. thick. This work has to be accomplished at low tide and was necessarily slow, as an average working day was only about six hours. By this method 5,363 piles were treated at an average cost of $1.36 per pile.

In 1917 it was found that the limmoria had extended their operations higher up on the piling and in some cases as high as the high-water mark. Cement paint, mixed one part cement and one part sand, was then tried as a protection. After adzing off the affected portions of the piles, the mixture was applied with 8-in. whitewash brushes. This was found to be quite satisfactory, but as only the affected portions were treated in this manner, the balance of the surface soon became affected and by the early part of 1919 the condition became very alarming. By this time a close examination showed that approximately 20 per cent of the bases put on in 1915 were failures due, according to Mr. Hickock, to the fact that hydrated lime had been used in the mixture. This apparently caused the concrete to disintegrate and shell off, for concrete made without the hydrated lime stood a test, and are as perfect today as when they were put in.

TRAIN CARRYING CEMENT-GUN WITH MIXER, COMPRESSOR, ETC., FOR GUNITING TIMBER PILES

During the early part of the present year it was noted that many of the piles had been eaten away until they were less than 5 in. in diameter. As painting piling with cement paint had stood the test of two years it was decided to use gunite. A cement-gun was accordingly purchased and mounted, as shown in the accompanying view, on two flat cars, together with a concrete mixer, air compressor tank for carrying supply of water, and bins for material. This train traveled along a trestle and the concrete protection was placed as required.

As the piles are submerged most of the time and the concrete has little chance to become dry, a condition which would probably cause the timber to shrink and the coating to crack, the greater portion was treated without the use of any reinforcement. The gunite was applied directly on the wood surface, and varies in thickness from a heavy coat of paint to 2 in. thickness. The greater part, however, carries a coating of about ½-in. thick. When the piles have been eaten away to such an extent that their strength is greatly reduced, 2-in. mesh chicken wire is used as reinforcement, and the piles built up to approximately their original size. A coating of gunite 6 to 8 in. thick was not uncommon when reinforcement was used.

The mixture was often carried through the hose for a distance of 300 ft. The pressure carried in the material hose is 28 lb. per sq.in., while the pressure on the water hose is 45 lb. This permits a thorough mixing in a specially designed nozzle before application. The sharp sand is driven into the surface of the piles with considerable force, which, in the opinion of the operators, not only kills all animal life but causes the gunite to adhere to the surface. As the other particles of cement and sand are forced on top of those already placed, the gunite is driven still further with a certain rebounding action which causes a loss of about 25 per cent of the sand. Very little cement, however, is wasted, and the resulting mixture was approximately 1 part cement and 2 parts sand. While this work is more or less experimental it has the appearance of being very permanent.

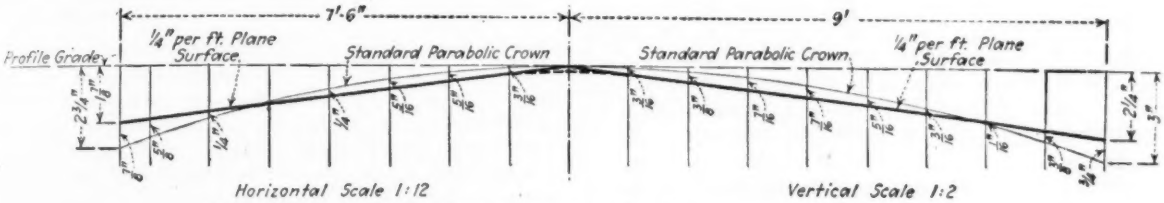
Inclined Planes Instead of Curve Suggested for Highway Surfaces

AT A recent meeting of engineers where highway paving was under discussion, the following comment on pavement crown was presented.

A study of conditions in the field shows that on nearly every road whose cross-section is a parabolic curve the central portion is too flat, and during the rainy season water often stands along the center portion. Of course this would not be true if the theoretical curve were followed absolutely, but, particularly after a little wear, the average road section is far from theoretically correct.

The parabolic camber gives a constantly increasing steepness to the outer edge so that when a vehicle starts to slide the slide will be increased toward the side of the road by the constantly increasing steepness. On a straight road there can be no reason for any crown at all except for drainage purposes. Two plane surfaces meeting at the center would take care of drainage more effectively because the central portion will be as well drained as that further toward the edges. The suggested revision is that the cross-section be made of two plane surfaces sloping away from the center line at the rate of ¼ in. to the foot, the peak being rounded by a curve, tangent a foot or two on either side of the center. A typical section of the type suggested is illustrated in the accompanying sketch in which the heavy line shows the proposed plane surfaces.

Another advantage of the cross-section shown in heavy lines is that when a vehicle keeps to one side of the road, broad tires would be given a bearing for their full width, which is not the case with the curved surface. In a western state last year 12- to 15-ton loads were hauled on a truck with 18-in. iron wheels. This truck cut into the concrete paving and damaged it seriously because only the inner edges of each tire secured a bearing on the curved surface of the road.



SUGGESTED CROSS-SECTION OF ROAD MADE UP OF TWO PLANE SURFACES

Railway Electrification Plans for South Africa

Increase Traffic Capacity by Electric Traction—Direct-Current System—Narrow Gage Governs Engine Design

ELECTRIFICATION as a means of effecting a 50 per cent increase in traffic capacity on the South African Government Railways, with greater economy than by the purchase of additional equipment and the physical improvement of the lines for steam traction, is the conclusion of a recent report made to the railway administration by Charles H. Merz and Wm. McLellan, consulting engineers, London, England.

The lines are mainly single track and the increase in traffic capacity would be effected by higher speeds and heavier train loads, with a reduction in total number of trains. As the speeds would be about the same for passenger and freight traffic, the present sidetracking of the slower trains would be reduced materially, while any increase in capacity with steam traction would require the construction of additional tracks and passing-sidings. Runs which now take about 2½, 2¾ and 8 hours would be reduced to 1¼, 2½ and 5¾ hours respectively.

Recommendations for electrification cover four heavy-traffic sections aggregating about 760 mi. of main line and 100 mi. of branches, including the suburban lines, with a total of nearly 1,200 mi. of track. Further, the report considers eventual extension of electric traction over the entire main line from Cape Town to Komati Poort, over 1,000 mi., and its 300-mile branch to the port of Durban on the east coast. From Komati Poort a 60-mi. railway extends across Portuguese territory to the port of Lourenco Marques.

The first section is from Cape Town northeast to Touws River, 160 mi., with suburban traffic around Cape Town and with a ruling grade of 2.5 per cent. This would have a power station at each end, so as not to rely entirely upon one station and a transmission line. The second section is from Komati Poort west to Witbank, 223 mi., with a circuitous location, numerous sharp curves and a ruling grade of 2 per cent, rising from an elevation of 600 ft. to 4,144 ft. above sea level. The main power station would be at the eastern end of the line.

Power Plant Projects

The third section is a continuation of the second, from Witbank to Randfontein, 131 mi., having a ruling grade of 1 per cent against the heavy coal traffic to Cape Town. A power station at the Great Olifants River would serve this section and supply some current for the adjacent section, while power might be obtained also from the private hydro-electric plant at the great Victoria Falls on the Zambesi River. The fourth section is from Durban, Natal, north to Glencoe, 249 mi., on the line extending to the Komati Poort and Randfontein section. There is a heavy coal traffic southbound. The ruling grade is 3.33 per cent and the line extends from sea level to a summit elevation of about 5,000 ft. A power station would be located at each end of the line.

Engine mileage being increased, fewer engines would be required, so that over 400 steam locomotives would be released for other service or for sale. On the other hand, a 50 per cent traffic increase with steam traction would necessitate the purchase of about 150 locomotives and 1,000 freight cars of 40 tons' capacity, according to the report. Freight train mileage on the four divisions, with electrification, is estimated at 6,890,600 mi.

per year, a reduction of 30 per cent over that required for equal service with steam traction. Operating expenses are estimated to show a large reduction.

For the electric installation the estimated cost is $58,350,000 (at the pre-war rate of exchange), of which $32,000,000 is for power stations and transmission lines. This covers an allowance of $25,000,000 for steam equipment released and for new equipment and line improvements which would be necessary to provide for a traffic increase of 50 per cent if steam traction should be retained.

Electrical Equipment Proposed

Operation by direct current at 3,000 volts, transformed at substations from three-phase 50-cycle alternating current on the transmission lines, is recommended, representing a relatively cheap installation with low cost of maintenance. The system provides also for variable speeds, so that it is adapted to the conditions of this case, which include both main line and suburban service, both with electric locomotives and motor cars. It requires a rather large number of substations, these being spaced at intervals of 25 to 30 miles.

Special designs of locomotives are made necessary by the fact that the lines have a gage of 3 ft. 6 in., which does not permit of placing the motors between the wheels. The driving wheels will be grouped in four-wheel trucks, each truck having two motors geared to a countershaft between the axles. Crank arms on the ends of this shaft carry horizontal coupling rods attached to corresponding crank arms on the ends of the axles. Each freight locomotive for heavy service would consist of two double-trunk units coupled to form a 16-wheel engine. The weight would be about 134 tons, with a tractive effort of 64,000 lb. maximum and 48,000 lb. sustained for one hour, this being sufficient for hauling a train of 1,800 tons on a grade of 1 per cent and to haul trains of 1,200 and 1,800 tons on the level at speeds of 40 and 30 m.p.h. respectively.

Passenger Locomotives

Passenger locomotives would be of a similar type, but with four-wheel leading trucks, to insure safety at the higher speeds. These 80-ton engines would have a tractive effort of 38,000 lb. maximum or 13,000 lb. at one-hour rating. They could handle 600-ton trains at 55 m.p.h. on the level or 28 m.p.h. on grades of 1.67 per cent. These engines would have to operate on maximum grades of 2.5 per cent but as these are neither long nor numerous it was considered preferable to provide for the use of pusher engines at certain points. These engines are to be used only on the Cape Town section, the single or double-unit freight engines handling all trains on the other sections. For switching service there would be 66-ton eight-wheel double-truck engines having a tractive effort of 24,000 lb. maximum or 14,000 lb. at a speed of 12 m.p.h. Suburban trains would be made up of motor cars and trailers on the multiple-unit system. This system is expected to develop the suburban traffic considerably. The total equipment would include 262 locomotives and 136 motor cars.

In the district covered by the proposed electrification steam-power plants would be required, as no streams suitable for hydro-electric development are available, the flow being uncertain. Coal, however, is cheap and plentiful. Each power station would have from one to eight generating units of 8,000 k.w., except that the station at Komati Poort would have two of 5,000 kw. It is proposed that these should supply current to municipalities and industrial plants as well as to the railways. A catenary cable suspended from steel bridges would carry the trolley wire and engines and motor cars would be equipped with trolleys of the pantagraph type.

The Discharge of Smooth Wood-Stave Pipes and Wood Channels

Comparisons of Observed and Calculated Velocities in Large and Small Pipes and Open Conduits of Different Shapes

By Alfred A. Barnes
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During the year 1913 the writer had occasion to develop a series of exponential formulas for the flow of water in pipes and channels constructed of different materials, and among the formulas adopted was one for "clean planed wood troughs or flumes and new smooth wood-stave pipes." The results of the investigation and the experiments on which the various formulas were based have been published in the writer's "Hydraulic Flow Reviewed," but the reason for the present note is that the formula for the case mentioned above has received remarkable confirmation by certain experiments which have been carried out or have come to the writer's knowledge since the date that the formula was devised.

The formula is

$$V = 223.3\, R^{0.669}\, S^{0.586}$$

or

$$H = 0.0000981\, \frac{LV^{1.707}}{R^{1.126}}$$

where in foot-second units V is the velocity, R is the hydraulic mean radius, S is the hydraulic slope, H is the heat absorbed in friction and L is the length of the pipe or channel.

To show the range covered by the original experiments on which the formula was based, abbreviated Table I is necessary; in this table the velocities calculated by the above formula are compared with those observed in the experiments.

It will be seen at once that the formula is very comprehensive since it covers an open rectangular channel only 4 in. wide, a semicircular channel 4 ft. 7 in. in diameter and a pipe under pressure of 72½ in. in diameter, and it is therefore not confined (as so many formulas have been) to pressure pipes only.

In the experiments given there occur: (1) a small channel having a fixed slope, S, of 1 in 66, with the value of R being changed; these experiments serve to test the index of R for small values of R. (2) A larger channel having a fixed slope, S, of 1 in 667 with changing values of R which serve to test the index of R in the larger values. (3) A pipe under pressure having a higher but fixed value of R with the slope S in this case being altered from 1 in 9,434 to 1 in 1,736. This last set checks the index of S for flat slopes, and when combined with the first two sets which have steep slopes proves that this index is correct.

Yet in spite of the range of conditions, sizes, slopes and velocities covered by the 30 experiments, and in

TABLE I. COMPARISON OF VELOCITIES OBSERVED IN EXPERIMENTS WITH THOSE CALCULATED

Barnes' Formula: $V = 223.3\ R^{0.625}\ S^{0.556}$

Pipe or Channel and Authority	Remarks	R Feet	S	V Observed Feet Per Second	V Calculated Feet per Second	Percentage Difference
Rectangular open channel, 4 in. wide. Darcy and Basin, 1865	Carefully planed. Slope 1 in 65.789 Values of R varied	0.030	0.0152	1.87	1.898	—1.5
		0.043	0.0152	2.30	2.407	—4.4
		0.053	0.0152	2.68	2.764	—3.0
		0.061	0.0152	3.00	3.032	—1.1
		0.074	0.0152	3.56	3.445	+3.3
					Av.:	—1.3%
Semicircular open channel, 4 ft 7 in. diameter. Darcy and Basin, 1865	Slope 1 in 666-67 Values of r varied	0.390	0.0015	2.61	2.656	—1.7
		0.537	0.0015	3.23	3.280	—1.5
		0.632	0.0015	3.71	3.652	+1.6
		0.717	0.0015	4.04	3.969	+1.8
		0.796	0.0015	4.25	4.253	nil
		0.856	0.0015	4.51	4.462	+1.1
		0.921	0.0015	4.64	4.683	—0.9
		0.964	0.0015	4.87	4.826	+0.9
		1.015	0.0015	5.00	4.993	nil
		1.054	0.0015	5.18	5.118	+1.2
		1.096	0.0015	5.29	5.252	+0.7
		1.129	0.0015	5.45	5.356	+1.7
		1.148	0.0015	5.54	5.416	+1.9
					Av.:	+0.5%
Ogden Pipe Line, Utah. 72½ in. diameter. Marx, Wing and Hoskins, 1897	New, made of Douglas fir. Length, 2,710 ft. Values of S varied from 1 in 1836 to 1 in 9434	1.5104	0.000106	1.332	1.374	—3.0
		1.5104	0.000181	1.876	1.880	nil
		1.5104	0.000211	2.058	2.057	nil
		1.5104	0.000235	2.218	2.191	+1.2
		1.5104	0.000300	2.536	2.527	+0.4
		1.5104	0.000331	2.689	2.677	+0.5
		1.5104	0.000361	2.783	2.817	—1.2
		1.5104	0.000452	3.149	3.214	—2.0
		1.5104	0.000517	3.453	3.477	nil
		1.5104	0.000566	3.568	3.666	—2.7
		1.5104	0.000547	3.627	3.594	+0.9
		1.5104	0.000576	3.645	3.704	—1.6
					Av.:	—0.6%

Total excess difference ..... +0.5%
Total deficiency difference ..... —1.9%

Net difference ..... —1.4%
For 3 sets: Average difference ..... —0.47%

spite of the fact that the formula comprises a true constant (223.3) throughout, there are only two of the individual experiments which disagree with the formula by more than 3 per cent.

Many other experimental results are given in the book referred to above, but those quoted will serve to illustrate the general applicability of the formula. It was felt, therefore, that not only must the indices of both R and S be right but that this constant (223.3) must also be correct, seeing that the product obtained by its use agreed with the experimental value so closely in each individual case.

The writer was not prepared, however, for such close agreement—outside the range of experiments used—as is shown by certain observations made by F. C. Scobey in 1914 and 1915. These were conducted upon very large wood-stave pipes 6½ ft. and 12 ft. in diameter (for full description, see Bulletin No. 376, U. S. Dept. of Agriculture).

Out of the nine experiments on the pipe 6½ ft. diameter two were made at velocities below 1 ft. per second, and the writer has neglected these, according to his usual practice, since they are probably in the region of the critical velocity. Of the remaining seven experiments on this pipe only one appears to be inconsistent with the others, so that probably an air-lock vitiated this test. We are therefore provided with six satisfactory experiments on this large pipe, and these are given in Table II.

On the other and still larger pipe, 12 ft. in diameter, ten experiments were carried out and only the first appears inconsistent with the others. Hence in this case Mr. Scobey has provided us with nine most satisfactory experiments on an exceptionally large pipe, and these are also given in Table II.

The agreement between these 15 experiments and the writer's original formula is shown by the percentages in the last column. It will be seen that for the pipe 78 in. in diameter the formula agrees to 0.333 per cent on the average, with a maximum individual difference of + 2.3 per cent; and for the pipe 144 in. in diameter the average difference is — 1½ per cent, with a maximum individual difference of — 3½ per cent.

It would seem that even if the formula had been devised to suit these few experiments only it could probably not have been made to do so much more closely, but when it is remembered that this formula was evolved without any knowledge of these experiments and that while agreeing with the 12-ft. pipe it also answers for the small open channel 4 in. wide, its applicability to all slopes and sizes seems undoubted.

In order to show that experiments on *small* wood-stave pipes also agree with the formula, three observations made by Moritz in 1910 on a pipe 6 in. in diameter are also given in Table II. The hydraulic slopes in this case are much steeper than those for the 78- and 144-in. pipes, and the index of S is again subjected to a severe test. Yet the formula agrees to + 0.7 per cent with the average of the observations on this pipe, the maximum individual difference being + 3.7 per cent.

In addition to the above, the experiments made by Noble on another large pipe, 54.19 in. in diameter, are

TABLE II. FURTHER COMPARISONS OF OBSERVED WITH CALCULATED VELOCITIES

Barnes Formula: $V = 223.3\ R^{0.625}\ S^{0.556}$

Pipe or Channel and Authority	Remarks	R Feet	S	V Observed Ft. per Sec.	V Calculated Ft. per Sec.	Percentage Difference
Sunnyside Project, U. S. Reclamation Service. *6 in. diameter.* E. A. Moritz, 1910	Jointed wood-stave pipe. In use 4 months. Water columns for gradients. Discharges by Cipolletti weir. Test lengths 1892 and 2021 ft.	0.125	0.001973	1.526	1.472	+3.7
		0.125	0.004295	2.327	2.321	+0.3
		0.125	0.006889	3.000	3.062	—2.0
					Av.:	+0.7%
Seattle Water - Works, Washington. *54.19 in. Diameter.* T. A. Noble, 1901	Continuous stave pipe made of Douglas fir. In use 10 months. Length, 2246.7 ft. Gradients and velocities very carefully taken	1.129	0.000342	2.276	2.252	+1.1
		1.129	0.000342	2.282	2.252	+1.3
		1.129	0.000436	2.650	2.597	+2.0
		1.129	0.000557	3.045	2.997	+1.6
		1.129	0.000558	3.067	3.001	+2.2
		1.129	0.000672	3.408	3.346	+1.8
		1.129	0.000783	3.724	3.659	+1.8
		1.129	0.000856	3.924	3.856	+1.8
		1.129	0.000983	4.215	4.181	+0.8
		1.129	0.001076	4.419	4.409	+0.2
		1.129	0.001162	4.688	4.612	+1.6
					Av.:	+1.5%
Ephratah Pipe Line, Mohawk Hydro-Electric Co., New York. *78 in. diameter.* F. C. Scobey, 1915	Continjous stave pipe. Made of Douglas fir. Test length, 2650 ft. Discharges by calibrated tail-race and color tests	1.625	0.000115	1.506	1.512	—0.4
		1.625	0.000194	2.063	2.055	+0.4
		1.625	0.000215	2.18	2.182	nil
		1.625	0.000244	2.33	2.350	—0.8
		1.625	0.000243	2.40	2.344	+2.4
		1.625	0.000287	2.59	2.585	nil
					Av.:	+0.3%
Ottmar Pipe Line, Salmon River Power Co., New York. *144 in. diameter.* F. C. Scobey, 1914	Continuous stave pipe made of Douglas fir. Few months in use. Staves 4 in. thick. Test length 2169.3 ft. Discharges by calibrated submerged weir	3.000	0.000643	6.13	6.214	—1.3
		3.000	0.000615	6.19	6.054	+2.2
		3.000	0.000694	6.31	6.499	—2.9
		3.000	0.000724	6.44	6.662	—3.3
		3.000	0.000716	6.52	6.619	—1.5
		3.000	0.000770	6.69	6.907	—3.2
		3.000	0.000749	6.85	6.796	+0.8
		3.000	0.001061	8.22	8.334	—1.4
		3.000	0.001092	8.22	8.476	—3.0
					Av.:	—1.5%

Total excess difference ..... +2.5%
Total deficiency difference ..... —1.5%

Net difference ..... +1.0%
For 4 sets: Average difference ..... +0.25%

also given in Table II, since the writer was not aware of the existence of these when framing his formula. Here again the observed velocities conform very regularly to the calculated ones and the pipe is found to agree to + 1½ per cent with the formula.

On the average the four sets quoted in Table II agree with the formula to exactly 0.25 per cent, which happens to be even closer than the sets in Table II, upon which the formula was originally based.

The writer is aware that Mr. Scobey also experimented upon a still larger pipe, 162 in. in diameter, but the method of computing the velocity in this case is open to question. No discharges were taken but color was timed in one of the two parallel 9-ft. pipes into which the large pipe was divided, and seeing that the load on the second 9-ft. pipe was being varied, it is not safe to assume a constant velocity in the first pipe. The discharge of the 162-in. pipe appears in these experiments to be on the average 15½ per cent in excess of Mr. Scobey's own formula and 21½ per cent in excess of the Williams-Hazen formula. Hence the writer feels obliged for the present to regard these observations with suspicion, especially as the individual tests indicate a discrepancy of about 17 per cent among themselves.

Although outside the scope of the heading of these notes the writer must utter a word of warning to those who wish to design wood-stave pipes which shall discharge a given quantity. This warning is necessary because the conditions of flow in an unplaned or sawn wood pipe are entirely different from those in a smooth planed one. Any formula which attempts to combine these two classes into one is misleading, as the indices and constants are in fact quite dissimilar in the two cases, and one might just as well attempt to obtain a mean formula combining the flow in a concrete-lined conduit with that in one lined with dry masonry.

Those who are interested will find 123 experiments in the *unplaned* wood class given in the book previously referred to, together with a formula which agrees within 2 per cent with 93 of these.

Hence it is necessary before attempting to compute a discharge to determine definitely whether the wood of which the pipe line is to be constructed shall be planed or merely sawed. If the formula appropriate to the class be then employed, no disappointment with the result is likely to ensue.

Army Camp Garbage Prices for Two Years

By F. C. Bamman
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THE accompanying table shows the garbage prices at Army camps for the years ending June 30, 1919, and June 30, 1920. It does not cover all camps but with the big decrease due to demobilization, camps not shown can almost be considered as producing no garbage.

This same decrease in the Army's size has rather a startling effect on the revenue received from the sale of garbage; in fact, were it not for other wastes taken care of by the same clerical force, the cost of keeping track of quantities, etc., would exceed the amount being received by the Government for this waste. This, of course, does not take into account the big saving in foodstuffs which resulted through holding down the per capita per day wasteage, and a large part of the present work is said to be justified by the lessened consumption resulting from keeping track of the waste per capita.

A glance at the prices given would indicate that less is being received for the various items of waste than last year. This would doubtless be the case were it not for the fact that as good separation is impossible with the lesser amount of material available. Bread, for example, is only valuable as bread when sufficient accumulates daily to amount to a reasonable total. Failing to reach this total, what does accumulate finds its way into "other garbage" and is sold under that head. The fact that "other garbage" prices are on the whole somewhat higher than last year makes me believe that the income per ton of garbage, total garbage, will be higher with this year's prices than would have been the case had the prices of last year continued.

COMPARISON OF GARBAGE DISPOSAL CONTRACTS AT ARMY CAMPS FOR FISCAL YEARS 1918–19 AND 1919–20 AND FISCAL YEAR 1920

Prices are per 100 lb., unless otherwise stated, and are for material collected and delivered by the Army to contractor at a transfer and sorting station

	Fiscal Year 1918–19						Fiscal Year 1919–20					
	Bread	Cooked Meats, Raw Fats and Meats, and Grease	Bones	Other Garbage	Dead Animals	Trap Grease	Bread	Cooked Meats, Raw Fats and Meats, and Grease	Bones	Other Garbage	Dead Animals	Trap Grease
Brass	No contract						$0.50	$0.80 & 1.00	$0.50	$0.12	$1.50	
Custer	$1.00	$2.75	$0.60	$0.04	....	$0.50	1.00	2.75	.60	.04	2.50	20
Devens	.20	8.00	1.00	.05	2.50	.....	1.00	5.60	1.00	.11	5.00	
Dix	4.33	4.96	.95	.05½	1.50 & 3.00	.....	Two-year contract					
Dodge	1.00	3.00	.70	.05	3.00	.50	1.00	3.00	.70	.05	3.00	.....
Funston	1.50	2.50	.50	.18½	2.00	8.00	Garbage given away for hauling					
Gordon	1.50	3.25	.90	.12	2.00	.....	1.55	.40	.35	.15½	.50	.....
Grant	1.00	4.50	.80	.05	3.00	.50	1.25	2.60	.80	.07½	6.00	
Jackson	1.50	3.25	.90	.10	2.00	.....	Two-year contract					
Kearny	Contractor collects and pays $0.01 per man per month						Same contract as last year					
Knox	No contract						1.10	2.00	.55	.15	3.00	.50
Lee	3.00	4.50	.75	.02½	1.00	3.00	.02½	3.00	.75	.02½	2.00	.....
Lewis	.50	.50	.60	.15	1.00	.....	1.25	1.00	.50	.18	.....	.....
Meade	4.33	5.01	.95	.05½	3.00	.....	Government pays $9.50 & $11.50 for collection and removal, a ton					
Merritt	.....	4.00	.90	.05¼	1.50	.....	.....	3.00	.75	1.00 per yr.	1.00	.....
Pike	2.00	4.50	.75	.06	1.50	2.00	Two-year contract					
Sherman	1.50	3.25	1.10	.13	2.50	.....	.50	3.00	.25	.05	3.00	50
Taylor	1.75	3.50	1.05	.16	5.00 & 7.00	.....	1.25	2.00	1.00	.10	7.00	.....
Travis	1.20	2.25	.75	.41	2.80	.....	Two-year contract					
Upton	.25	4.00	.90	.05½	1.50	.50	Two-year contract					

River Rhone Development Plans

The plans for the development of the river Rhone, says *The Engineer*, include the use in Paris of 200,000 kilowatts for trams, the underground railway and for sundry other purposes, while the P.L.M. will derive the power for the electrification of its railways from the same source. The French Government intends to spend 820 million francs on the hydraulic power, 610 millions for navigation, 200 on irrigation and 150 millions on transport.

Estimating Manhole Costs

Description of Method Whereby Two Men Can Price With High Accuracy, From Field Notes, 100 Manholes Per Hour

By E. E. George
Electrical Engineer, Chicago

ORDINARILY, the pricing of underground manholes, for estimating or appraisal purposes, is done by classifying all kinds according to a few standard types whose costs may be calculated in detail. This article will develop a better method by which two men can price from the field notes 100 manholes an hour and come within 5% of theoretical accuracy. As the errors are equally distributed the probable error in the total of a group of 25 or more will be less than 1%—negligible as compared with the inaccuracies of the field measurements, and of the unit cost assumptions. The method devised by the writer was employed by A. L. Drum & Co., on the valuation of the Chicago surface lines, for appraising several thousand cable manholes, of four different shapes, three different materials, and with the width, length and depth varying independently from 2 to 12 ft.

The main feature of this method consists of expressing the costs of each of the component operations of construction in terms of the inside length, width and depth, and adding these costs, which gives a price equation in three variables. Such an equation is not adapted to rapid graphical solution, so one of the variables is removed by assuming a standard depth, and using a set of auxiliary correction curves to compensate for variations in depth. Lines of equal cost plotted against length and width as rectangular coördinates give nonrectangular hyperbolas for the basic curves. The depth correction curves are rectangular hyperbolas, symmetrical about the assumed depth, when plotted on the above chart, with the depth measured along the length scale.

To derive the equation, the following unit costs are assumed:

Brickwork, erected, per thousand	$40.00
Concrete, in place, per cubic yard	8.10
Reinforcing steel, erected, per pound	0.05
Form lumber, built, per square foot	0.20
Sheet piling lumber, in place, per square foot	0.05
Excavation, per cubic yard	1.00
Disposal, per cubic yard	1.25
Backfill per cubic yard	0.50
Frame and cover, in place, each	40.00

The following assumptions as to methods of construction are made:

Brick walls 8 in. or 0.67 ft. thick; reinforced concrete top 0.67 ft. thick; top of cover, 0.33 ft. above top of concrete; concrete floor, 0.50 ft. thick; excavation line, 0.67 ft. outside of wall; cover opening, 2 ft. x 2.50 ft.; bricks in place run 18 per cubic foot; reinforcing steel runs 8 lb. per sq.ft.; sheet piling is 5 ft. longer than inside depth.

A rectangular manhole will be used for illustration, but by the introduction of certain constants the formulas apply for all shapes, neglecting very slight inaccuracies due to the method of figuring cover areas.

Let C = number of covers on the manhole.
W = width of manhole inside in feet.
L = length of manhole inside in feet.
D = depth of manhole inside in feet.

The inside area of the manhole is $W \times L$. The area outside the walls is $(W+1.33) \times (L+1.33)$. The area of excavation is $(W+2.67) \times (L+2.67) = (W \times L) + 2.67\,(W+L) + 7.11$. The depth of excavation equals the assumed depth (5) plus roof thickness (.67) plus roof cover (0.33) plus floor thickness (.50), making a total of 6.50 feet.

$$\text{Volume of excavation} = \frac{6.50}{27} \times [(W \times L) + 2.67\,(W + L) + 7.11]$$
$$= .24\,(W \times L) + 0.64\,(W+L) + 1.71$$

Cost of excavation,
$$= 0.24\,(W \times L) + 0.64\,(W+L) + \$1.71$$

The area of disposal is $(W+1.33) + (L+1.33) = (W \times L) + 1.33\,(W+L) + 1.78$.

$$\text{Volume of disposal} \times \frac{6.50}{27} \times [(W \times L) + 1.33\,(W + L) + 1.78]$$
$$= 0.24\,(W \times L) + 0.32\,(W+L) + 0.43$$

Cost of disposal,
$$= 0.30\,(W \times L) + 0.40\,(W+L) + \$0.54$$

Volume of backfill = volume of excavation minus volume of disposal $= 0.32\,(W+L) + 1.28$.

Cost of backfill $= 0.16\,(W+L) + \$\ .64$.

Inside perimeter of brick wall equals $2\,(W+L)$.

Outside perimeter of brick wall equals $2\,(W+L)$. plus (8×0.67). Average perimeter $= 2\,(W+L) + (4 \times .67)$.
$$= 2\,(W+L) + 2.67$$

Volume of brick wall
$$= 5 \times 0.67 \times [2\,(W+L) + 2.67]$$
$$= 6.67\,(W+L) + 8.89$$

$$\text{Cost of brick} = \frac{40}{1000} \times 18 \times [6.67\,(W + L) + 8.89]$$
$$= 4.80\,(W+L) + \$6.40$$

Perimeter of sheet piling equals $2\,(W+L) + (8 \times 1.33) = 2\,(W+L) + 10.67$.

Area of sheet piling $= 10 \times [2\,(W+L) + 10.67]$

Cost of sheet piling $= 0.05 \times 10 \times [2\,(W+L) + 10.67]$
$$= (W+L) + \$5.33$$

Cost of frames and covers $= 40\,C$

Area of concrete floor $= (W+1.33) \times (L+1.33)$
$$= (W \times L) + 1.33\,(W+L) + 1.78$$

$$\text{Volume of concrete floor} = \frac{0.5}{27}[(W \times L) + 1.33\,(W + L) + 1.78]$$

$$\text{Cost of concrete floor} = \frac{8.10 \times 0.5}{27}[(W \times L) + 1.33\,(W + L) + 1.78]$$
$$= 0.15\,(W \times L) + 0.20\,(W+L) + 0.27$$

Area of concrete roof
$$= (W \times L) + 1.33\,(W+L) + 1.78 - (2 \times 2.50)\,C$$

$$\text{Cost of concrete roof} = \frac{8.10 \times 0.67}{27} \times [(W \times L) + 1.33\,(W + L) + 1.78 - 5\,C]$$
$$= 0.20\,(W \times L) + 0.27\,(W+L) + 0.35 - 1\,C$$

Area of reinforcing
$$= (W \times L) + 1.33\,(W+L) + 1.78 - 5\,C$$

Cost of reinforcing,
$$= 0.05 \times 8 \times [(W \times L) + 1.31\,(W+L) + 1.78 - 5\,C]$$
$$= 0.40\,(W \times L) + 0.54\,(W+L) + 0.70 - 2\,C$$

Area of forms
$$= (W \times L) + 1.13\,(W+L) + 1.78 - 5\,C$$

Cost of forms
$$= 0.20 \times [(W \times L) + 1.33\,(W+L) + 1.78 - 5\,C]$$
$$= 0.20\,(W \times L) + 0.27\,(W+L) + 0.35 - 1\,C$$

Paving is usually figured separately, so it will be omitted here.

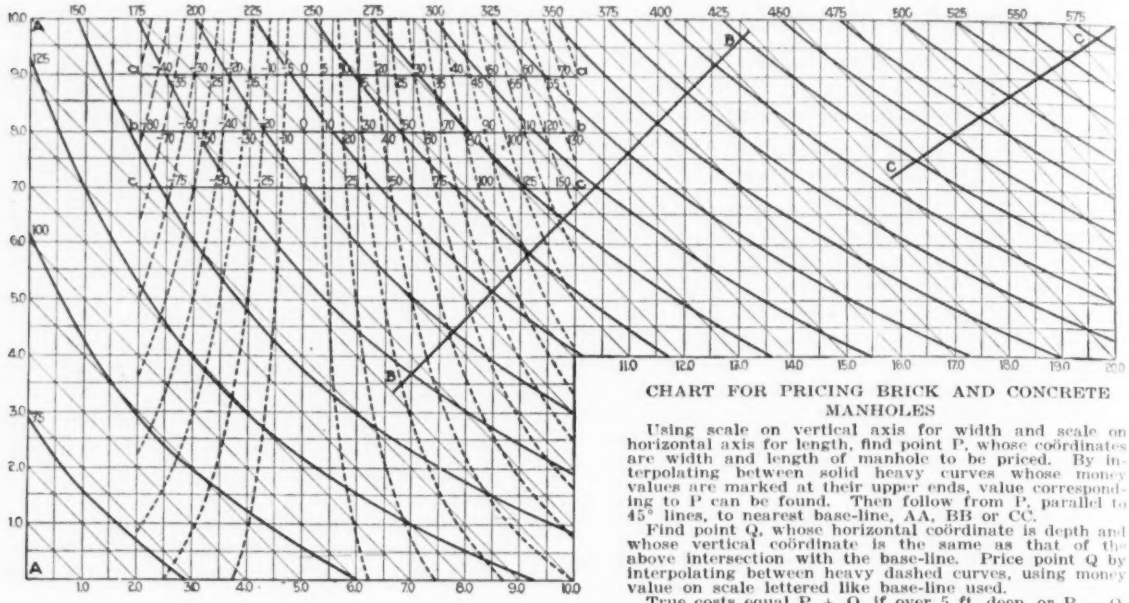

CHART FOR PRICING BRICK AND CONCRETE MANHOLES

Using scale on vertical axis for width and scale on horizontal axis for length, find point P, whose coördinates are width and length of manhole to be priced. By interpolating between solid heavy curves whose money values are marked at their upper ends, value corresponding to P can be found. Then follow from P, parallel to 45° lines, to nearest base-line, AA, BB or CC.

Find point Q, whose horizontal coördinate is depth and whose vertical coördinate is the same as that of the above intersection with the base-line. Price point Q by interpolating between heavy dashed curves, using money value on scale lettered like base-line used.

True costs equal P + Q, if over 5 ft. deep, or P — Q, if less than 5 ft. deep.

EXAMPLE—Manhole 7.4 × 8.8 × 6.9 ft. Point P with coördinates 7.4 and 8.8 lies between $275 and $300 curves at about $280. Following from P parallel to 45° line to BB base-line, 6.4 is vertical coördinate and 6.9, the depth, is horizontal coördinate of Q. Q lies between $40 and $50 correction curves (using bb scale) at about $45. Cost = $280 + $45 = $325.

Summing up all of the above items of cost:

Excavation = + 0.24 $(W\times L)$ + 0.64 $(W+L)$ + $1.71
Disposal = + 0.30 $(W\times L)$ + 0.40 $(W+L)$ + .54
Backfill = + 0.16 $(W+L)$ + .64
Wall brick = + 4.80 $(W+L)$ + 6.40
Sheet piling + $(W+L)$ + 5.33
Frames and covers = + 40 C
Concrete floor = + .15 $(W\times L)$ + 0.20 $(W+L)$ + 0.27
Concrete roof = +.20 $(W\times L)$ + .27 $(W+L)$ +.35—C
Steel reinforcing
= + .40 $(W\times L)$ + .54 $(W+L)$ + .70—2 C
Reef forms = + .20 $(W\times L)$ + .27 $(W+L)$ + .35—C
TOTAL COST— 1.49 $(W\times L)$ + 8.28 $(W+L)$ +$16.29 +36 C.

As there is usually but one cover to a manhole, C may be considered as unity in plotting the cost curves, and $36 may be added mentally to the final result when necessary to price a manhole with two covers. Thus, total cost = 1.49 $(W\times L)$ + 8.28 $(W+L)$ + $52.29, for a manhole 5 ft. deep. Every foot variation in depth will change the excavation, disposal, backfill and wall brick by 20%. It may be assumed that the same piling lengths will be used everywhere on the job (the surplus being left above the ground), so variations in piling cost with depth may be neglected. The additional cost for any depth will be:

$(D-5) \times 0.20 \times [.54\ (W\times L) + 6\ (W+L) + 9.29]$
$= (D-5) \times [0.11\ (W\times L) + 1.20\ (W+L) + 1.86]$

As will be seen by plotting $[0.11\ (W\times L) + 1.20\ (W+L) + 1.86]$ against W and L, the resulting graphs are almost straight lines. The hyperbolic curvature due to the coefficient of $(W\times L)$ is so small that it is desirable to eliminate it. With the values of W and L used most frequently, .11 $(W\times L)$ may be equal to, say, 0.30 $(W+L)$. Thus, the depth correction will be:

$$(D-5) \times [1.50\ (W+L) + 1.86]$$

Several factors tend to minimize the error involved in the above approximation. First, the total correction for depth is a small part of the total cost. Second, if the average depth (5 ft. is used above) is properly chosen, so that the depth corrections may be about equally additions or subtractions, the plus and minus errors will nearly cancel. Third, if the average width and length are well chosen, the plus and minus errors will nearly cansel. The above correction equation is the product of two factors: D and $(W+L)$. If $(D-5)$ is measured along the horizontal axis, and $(W+L)$ along the vertical axis, any value of the equation will be represented by a pair of rectangular hyperbolas, symmetrical about the vertical line $D=5$, and asymptotic to the horizontal line $(W + L) = -\frac{1.86}{1.50}$. All points lying on a line at 135° with the horizontal axis have the same value of $(W+L)$, and this value may be read by the vertical scale of width at the intersection of the vertical axis and the slanting line. The correction curves may thus be plotted.

The curve chart herewith was not based on the above equations:

Cost = 1.49 $(W\times L)$ + 8.28 $(W+L)$ + 52.29,
Correction = $(D-5) \times [1.50\ (W+L) + 1.86]$
but, due to different unit costs, on the equations:
Cost = 1.53 $(W\times L)$ + 7.80 $(W+L)$ + 52.
Correction = $(D-5) \times [1.20\ (W+L) + 4$.

The method of calculating the points for the curves is shown below:

Cost = 1.53 $(W\times L)$ + 7.80 $(W+L)$ + 52.
To get the curve of $150 cost:
150—52 = 98 = 1.53 $(W\times L)$ + 7.80 $(W+L)$
98 = 1.53 $(W\times L)$ + 7.80 W + 7.80 L
98 — 7.80 L = (1.53 L + 7.80) W

$$W = \frac{98 - 7.80\ L}{1.53\ L + 7.80}$$

Substitute above: $L = 0$, $L = 0.5$, $L = 1.0$, $L = 1.5$, etc., on up to $L = 10$ (or larger) and find W. Plotting corresponding values will give the curve of $150 cost.

To get the curve of $175 cost:

$$175 - 52 = 123 = 1.53\ (W \times L) + 7.80\ (W+L)$$

$$W = \frac{123 - 7.80\ L}{1.53\ L + 7.80}$$

With a Bruns-Vega or similar calculating machine (or even a repeating adding machine) the above calculations can be quickly made. It will be noticed that the curves are hyperbolas, and are equidistant horizontally and vertically. After two curves are found, the others can be stepped off with a pair of dividers, but it is imperative that one or more of the curves far from the starting point be plotted from calculated data, so that the divider setting can be checked and corrected, or the cumulative error may be very large. The accompanying curve chart was calculated, plotted and inked, on a 25 x 50 inch tracing, by one man, in less than a day, so it is evident that the original cost is not excessive. With cost curves $25 apart, interpolations can easily be made to $5, which is less than 5%. The depth corrections can be made even closer, but it is usually not necessary. With this degree of accuracy, the use of the graphical chart by two men is several times faster than the slide rule.

The correction curves are plotted in much the same way as the basic curves.

$$\text{Correction} = (D\text{—}5.0) \times [1.20\ (W+L) + 4]$$

$$\frac{\text{Correction}}{(D - 5.0)\ (1.20)} = (W + L) + \frac{4}{1.20}$$

$$W + L = \frac{\text{Correction}}{1.20\ D - 6} - 3.33.$$

To get $10 curve:

$$W + L = \frac{10}{1.20\ D - 6} - 3.33.$$

Let D equal 0, 0.5, 1, 1.5, 2, etc., and find $(W+L)$. $(W+L)$ is measured along the vertical axis, and D along the horizontal. As $(W+L)$ runs off the chart, a new base line, BB, representing half its value (measured from —3.33, which is the real axis of the correction curves) is introduced, and the money scale is doubled. This process can be repeated as often as necessary, and it will keep the values of $(W+L)$ on the chart. Certain parts of the chart may be left blank if it is evident from the manhole sizes that such ranges will not be needed.

For oval manholes, the values of $(W \times L)$ and $(W+L)$ need only be multiplied by a constant (usually between $\frac{\pi}{4}$ and 1.00) to get the true inside areas and perimeters. As the constant term of the equation represents rectangular corner areas and perimeters, it should likewise be multiplied by the constant. Fortunately, the same constant applies to arcs and to perimeter, at least closely for shapes made up of straight lines and second degree curves (conic sections), so that the final cost need only be multiplied by this constant to be applicable to an oval manhole of the length and width used.

On one system it was found that this constant for oval manholes was 0.85. It is believed that this is a representative figure for all flat-ended curved-sided manholes. Perfect circles or ellipses would give .7854. In the above case, the constant, .85, was found by plotting true areas and perimeters, as determined by planimeter and curve-tracer, against apparent rectangular areas and perimeters, for several representative shapes.

The basic equation for oval manholes becomes:

$$[1.49\ (W \times L) + 8.28\ (W+L)\ 52.29] \times .85 = \text{Cost.}$$

The correction equation, for oval manholes, becomes:

$$(D - 5) \times [1.50\ (W+L) + 1.86] \times .85 = \text{Correction.}$$

Rather than plot the new equations, the simplest method is to multiply the corrected result, found in the usual way, by .85. In a few cases it might be desirable to use the exact shape in deriving the equations, if all the manholes of the system are built closely to a simple mathematical figure, such as the circle, oval or hexagon.

The general method of pricing herein outlined is applicable to a wide range of structures: Cable, steam-pipe, and gas-main manholes; cisterns, silos, tanks, open caissons, intake shafts, grain elevators, and other one-roomed buildings whose costs are directly proportional to surface and volume.

Financier Characterizes Contractor

IN A recent issue of one of the New York daily papers appears an article by Richard Deming, vice-president American Surety Co., New York City, in which an appeal is made for closer co-operation between owner and contractor. The following epigrammatic phrases are a fair resumé of Mr. Deming's article:

"There are more doubtful elements in a construction job than in any bill of goods. It requires either more 'nerve' to take chances or more 'gall' to cover chances.

"When a manufacturer sees that costs are running ahead of estimates, all he need do is to send out a little 'announcement to the trade,' which 'passes the buck' to the consumer. When a contractor finds himself on a losing job under the usual form of contract he can overdraw his bank account, mortgage his house or equipment, or call a meeting of the creditors.

"The contractor must be resourceful in meeting unforeseen and unforeseeable conditions—the trickiness of soil and sub-soil, of earth and the waters under the earth—and the weather.

"A contract does not have to be what it so often is—handcuffs and chains which the owner puts on the contractor, defying him to do his best.

"Specifications should be a practical set of scientific standards for a workmanlike job—not an anthology.

"The owner has nothing to lose by paying the contractor promptly.

"In the preparation of plans and specifications, the owner can do much to help or hinder the contractor—and himself.

"Unnecessary use of expensive material, or too much material, or complex and costly methods are frequent requirements which cause contractors gray hairs and owners high cost.

"A growing evil is 'scrap book' specifications, compiled with more diligence than judgment by young engineers who clip 'good clauses' from many sources and combine them into a crazy-quilt style of exasperating inconsistency and self-contradictions."

"In general," says Mr. Deming, "in the actual construction of a building or any other project, the contractor takes the risk. The more the risk the contractor is asked to take, and the less certain the probability of profit, the higher will be the cost of construction, and the greater will be the chances of failure. It is therefore up to the owner to reduce the hazards of the industry as far as is in his power—not only as an individual on his own particular work, but as a member of any organization of owners, to which he may belong."

What Is the Future of Inland Water Transportation?—*Part V*

By Charles Whiting Baker
Consulting Editor, Engineering News-Record

The Federal Government has invested nearly $15,000,000 in boats to operate on three inland waterways where prospects of commercial success are most favorable. The operating expenses alone of these boat lines from October, 1918, to July 1, 1919, exceeded their earnings by $543,000. This includes nothing whatever for interest, insurance and depreciation on the boats and other equipment used. This experiment, however, should be continued until it is fully demonstrated whether it is possible in the most favorable location to carry freight by water at lower cost than by rail.

A St. Lawrence River waterway from the Lakes to the Atlantic large enough for the Lake shipping offers greater prospect of commercial success than any other waterway project now proposed because it would cut out the entire terminal expense at the seaboard and allow vessels to carry freight without transfer all the way from the Lake cities to foreign ports.

In general, water transport has the best chance of success where long distances are covered and where railway terminal costs are very high. These conditions favor the proposed ship canal across New Jersey.

XII—Concluded from page 191

Government Operation of Boats on Inland Waterways

When the United States entered the war and the congestion of traffic on the railways became serious, there was a general belief that at last the opportunity for the inland waterways had come. Here were channels which the Government had spent millions to improve for navigation, and freight urgently needing to be moved which the railways were unable to handle.

The difficulty at once found was that there were not enough boats in existence on inland rivers to render any important service in handling long-distance traffic. The few boats still running were antiquated craft, used only for unimportant local traffic. It was hoped that private enterprise would seize the opportunity and build boats for inland transport, but the hope was unrealized. Most of the older generation of river steamboat men have passed away with their craft. Such as survive are unfamiliar with modern business methods.

Besides this, if anyone in 1917 could have brought together the capital and the steel and the lumber necessary to build a river steamboat, he would have done far better to build a craft for ocean traffic, where rates had gone up several hundred per cent, than a boat for river traffic to compete with railways, which had only raised their rates 25%. Under these conditions, the inducement to private capital to go into the river-steamboat business was conspicuous by its absence.

Vicissitudes of River Transportation

The pressure for transportation was such, however, that every navigable craft on the rivers was pressed into service, including even Government vessels ordinarily used on its works of channel construction and maintenance. Among these on the Mississippi was an experimental Government towboat, the "Nokomis."

A number of years ago it became obvious that something besides lack of navigable channels was responsible for the decline of water transport, and one theory which found favor was that the old-time stern-wheel river steamboat was antiquated. In 1910 Congress ordered an investigation to be made to determine whether more economical types of boats could not be used on the Mississippi River system. This investigation has been in progress ever since.

The "Nokomis" was one of the improved towboats under trial by the Engineer Department which were turned over in the summer of 1917 for commercial traffic. The story of her service of a few months, as related in the official report, is illuminating because it illustrates graphically the slowness and vicissitudes of river navigation which hamper it in competition for business.

The "Nokomis" left St. Louis, July 30, 1917, with six barges loaded with coal to be delivered at St. Paul. She started with a load of 2917 tons of coal. In the month and a half required for the voyage to St. Paul she burned about one-sixth of the coal under her boilers. She started back to S. Louis, Aug. 28, with 10 barges loaded with 3560 tons of iron ore; but because of low water and frequent groundings she did not reach St. Louis till Oct. 20.

The "Nokomis" was then put into use by the Army Quartermaster service, and undertook to tow 15 steel barges, taken from the St. Louis engineer district, to New Orleans. These barges were loaded with knocked-down railway cars which were to go to France. The "Nokomis" started from St. Louis, Nov. 27, with seven barges. She left them at Cairo and returned for the remainder, the plan being to assemble the whole tow at Cairo for movement southward. She again left St. Louis with seven bargeloads of railway cars and one of fuel on Dec. 27, but running ice and a heavy storm forced her to take refuge just below the city limits, where she was frozen in and had to stay. Of the seven barges tied up at Cairo, two listed so heavily as to dump their loads, and two broke away and were carried downstream.

The "Nokomis" again started south Feb. 26, 1918, when the river became clear of ice, picked up the other barges on the way down and reached New Orleans Mar.

11. She started back with the empty barges Mar. 23 and reached St. Louis Apr. 27. The lost cars were practically all recovered at the next low-water season by divers and an electro-magnetic derrick, and at the end of the year, the official report says, were being overhauled at Memphis for reshipment to New Orleans, notwithstanding the fact that the need for the cars in France had passed!

Railway Administration's Operation of Boats

After Government control of the railway lines was established, it was natural that control should be extended to the water transport lines. Director General McAdoo in his report at the close of 1918 said:

"It has seemed to me evident that by developing transportation on the waterways and coördinating and articulating them with a unified railway system, we shall bring about a correct solution of the rail-water controversy, which has been in progress for fifty years. This is possible with the railways under Federal control. I doubt if any of our rivers or canals will become active factors of transportation if the railways are turned back to private control."

In accordance with these ideas, Mr. McAdoo appointed a committee, in February, 1918, to prepare a plan for the increased use of the waterways to relieve the railway congestion. This committee reported in April and in the following month the New York Barge Canal section was organized. Its operations with about 200 old canal boats which it leased for use in 1918 were briefly described in Chapter VIII. Besides these old boats, contracts for new equipment to the value of about $4,500,000 for operation on the barge canal were authorized. Late in July, 1918, the Mississippi-Warrior River section of the Railway Administration was organized and about $9,680,000 was provided for the purchase of old boats and the building of new ones.

These three inland waterways were selected as offering the best opportunities for the development of a profitable traffic; and it was believed that if the Government could demonstrate the feasibility of operating boats on these channels at a profit, private capital would be induced to embark largely in the building and operation of boats.

The equipment purchased for the New York barge canal consists of four steel tugboats and three 550-ton wooden barges. The new equipment built to the Government order consists of 51 steel barges of 650 tons each, 21 concrete barges of 550 tons and 21 self-propelled barges of 400 hp. Of this equipment, there had been delivered, on Sept. 1, 1919, 48 steel barges and 18 concrete barges, and 6 of the self-propelled barges were to be delivered in October.

For operation on the lower Mississippi River the Government purchased from the Kansas City Missouri Navigation Co. 2 small steamers and 9 barges and leased from the Mississippi River Commission 3 steamers and 20 barges, and began operations in October, 1918. The new equipment ordered for this division consists of 6 towboats of 1800 hp. each and 40 cargo barges 230 x 45 x 11 ft. of 2000 tons capacity each.

For the Warrior River operations, 3 towboats, 3 colliers and 6 self-propelled barges and 23 cargo barges were purchased; and new equipment was ordered consisting of 3 towboats, 4 self-propelled barges and 20 cargo barges.

Of the total amount of $9,681,087 provided for purchase and construction of equipment for the Lower Mississippi and Warrior Rivers, $4,223,542 had been expended on Sept. 1.

Turning now to the financial results obtained in operating these boat lines, these were given by Director Tomlinson in a statement before the House Committee on Interstate and Foreign Commerce, on Sept. 18, 1919.

The results of operation on the New York barge canal from Jan. 1 to July 1, 1919 (the canals opened on May 15) were reported as follows:

Tonnage Handled:		Tons
Eastbound		20,454
Westbound		9,874
Total		30,328
Revenue		$93,089 22
Expenses:		
Overhead—		
Traffic	$8,710 88	
Operating	12,667 80	
General	17,797 35	
	$39,138 03	
Repairs	11,298 56	
Fuel	2,554 04	
Charters	20,442 24	
Towing	16,669 82	
Vessel and tug supplies	11,740 01	
Wages of crews	54,366 11	
Miscellaneous	7,064 22	
Depreciation	2,327 46	
Total		$165,600 49
Net operating income (loss)		$72,511 27

For July and August the tonnage and earnings of the New York Canal section were as follows:

	Tonnage	Revenue
July	30,240	$85,159
August	30,731	89,769

The profit earned in the month of July was $4,359.48.

The financial results of operation on the lower Mississippi and Warrior Rivers from the start in October, 1918, to the end of June, 1919 are given in the accompanying tables. It will be seen from these tables that the total losses incurred in the operation by the Government of these three boat lines to June 1, 1919, were as follows:

New York canal section	$72,511
Lower Mississippi section	411,168
Warrior River	58,414
Total	$542,093

The total freight handled during this period was 30,328 tons on the New York barge canal, 85,377 tons on the Lower Mississippi and 42,586 tons of coal on the Warrior River.

Thus the loss averaged $2.40 per ton of freight moved on the New York barge canal, $4.82 on the lower Mississippi and $1.40 per ton of coal carried on the Warrior River.

The operations of these Government boats have been widely advertised as rendering valuable service to shippers by carrying cargo at 80% of the railway rates; but the above figures show that even the full railway rate would not have nearly met the cost of moving the freight by water.

Even this is not the whole story, for the above figures cover only the direct operating expenses of the boats. To find the entire cost of carrying the freight by water there would have to be added the interest and depreciation on the boats used and also insurance on them to cover risk of loss, for the Government, it appears, according to Director Tomlinson's testimony, does not carry insurance. The effect of losses on the total cost of marine transport is well illustrated in the experience

shown in the above report of the Mississippi River operations, where the sinking of a barge load of coffee added $85,000 to the operating expenses for April, 1919.

It is claimed of course that the operations thus far with old boats are no criterion of the results which will be obtained when the new equipment is all completed and in service. It is worth noting, however, that the "old boats" which are in use on the lower Mississippi include the very steamers and barges on which the Kansas City Navigation Co. expended a large amount in order to secure the most efficient and economical equipment possible. They include also the towboats which the Corps of Engineers built to represent the latest improvements in river navigation. If these vessels, built only half a dozen years ago, are now obsolete, then a very high rate for depreciation and obsolescence must be charged against investments in river craft.

It is of interest to turn, however, to the situation which the Government must meet in order to show a profit from next year's operations of its boats. Its investment in vessels of about $14,500,000 will be subject to an interest charge which at present prices of Government bonds can hardly be less than 5% and to depreciation which can surely be not less than another 5%. If then these Government boats are to demonstrate that inland water transportation is a profitable business, they will have to earn next year a profit above all operating expenses of at least $1,450,000, in order to cover their fixed charges alone. Director Tomlinson also submitted figures showing a total salary pay roll for the organization which operates these three waterways of $273,500 per annum. This does not include the daily labor pay roll nor the crews on floating equipment.

The probability at present appears to be that with the winding up of the Federal Railway administration this experiment in Government operation of waterways will be turned over either to the Shipping Board or the War Department. That the experiment must be carried through admits of no doubt. Unless the Government can demonstrate that there is a good profit in the inland water transport business, private capital will not engage in it.

The complete failure of the Inland Transportation Co. and the Kansas City Missouri Navigation Co., the only two important attempts for years to revive long distance inland water transportation, with the disappearance of profits in the coastwise transportation business, all operate as warnings to private capital to steer clear of such investments.

Of course it may be claimed that the Government's entering into this business acts to deter private capital from it; and the New York State authorities, in fact, have strongly opposed the operation of boats on the state barge canal by the Federal authorities.

Their opposition rests on no sound grounds however. New York's $150,000,000 barge canal lies almost unused, nor is there prospect of any great increase in its traffic unless the present Federal Government experiment proves successful enough to encourage private capital to enter the business on a large scale.

UNITED STATES RAILROAD ADMINISTRATION, DIRECTOR GENERAL OF RAILROADS

Report of operations, Mississippi-Warrior waterways, ten months ended June 30, 1919

WARRIOR RIVER SECTION

	October, 1918	November, 1918	December, 1918	January, 1919	February, 1919	March, 1919	April, 1919	May, 1919	June, 1919	Total
Operating Revenues										
Freight revenue	$1,763.50	$2,446.50	$3,210.93	$17,027.07	$11,754.54	$12,136.30	$9,488.79	$9,732.25	$16,013.31	$83,572.99
Miscellaneous		303.95	1,315.72	1,817.71	1,946.96	2,025.30	1,059.38	1,728.02	5,915.27	16,112.31
Total	$1,763.50	$2,750.25	$4,526.65	$18,844.78	$13,701.50	$14,161.60	$10,548.17	$11,460.27	$21,928.58	$99,685.30
Operating Expenses										
Maintenance	$1,370.42	$1,669.69	$3,543.09	$4,662.24	$4,723.79	$3,222.68	$5,428.37	$4,481.56	$9,130.54	$38,232.47
Transportation expenses	2,122.30	2,440.59	4,408.17	15,033.68	15,477.03	12,544.65	8,977.07	12,572.02	18,052.06	91,627.57
Overhead expenses:										
Traffic expenses	381.69	385.22	415.67	525.09	566.26	593.59	585.46	546.99	602.85	4,602.82
General expenses	1,151.87	1,021.83	958.89	1,626.68	1,411.78	1,356.65	1,536.06	1,654.55	1,506.14	12,224.45
Total	$5,026.28	$5,517.33	$9,325.82	$21,847.69	$22,178.86	$17,717.57	$16,526.96	$19,255.21	$29,291.59	$146,687.31
Operating income (loss in italics)	*$3,262.78*	*$2,767.08*	*$4,799.17*	*$3,002.91*	*$8,477.36*	*$3,555.97*	*$5,978.79*	*$7,794.94*	*$7,363.01*	*$47,002.01*
Other income (debts in italics)	465.87	*364.31*	*1,460.46*	*1,354.03*	*1,864.09*	*1,842.87*	*1,601.38*	*1,700.04*	*1,690.20*	*11,411.51*
	$2,796.91	*$3,131.39*	*$6,259.63*	*$4,356.94*	*$10,341.45*	*$5,398.84*	*$7,580.17*	*$9,494.98*	*$9,053.21*	*$58,413.52*

MISSISSIPPI RIVER SECTION

	October, 1918	November, 1918	December, 1918	January, 1919	February, 1919	March, 1919	April, 1919	May, 1919	June, 1919	Total
Operating Revenues										
Freight revenue	$27,305.41	$19,857.69	$24,516.35	$13,408.88	$25,436.58	$51,321.38	$39,616.35	$40,277.70	$35,259.12	$277,000.36
Miscellaneous		1.58	2.07		69.94	115.22	194.51	33.00	37.00	453.32
Total	$27,305.41	$19,859.27	$24,518.32	$13,408.88	$25,506.52	$51,436.60	$39,810.86	$40,310.70	$35,296.12	$277,453.68
Operating Expenses										
Maintenance	$7,534.86	$8,095.41	$14,410.60	$3,462.26	$5,579.17	$4,239.52	$10,868.07	$12,686.51	$13,436.98	$80,313.38
Transportation expenses	31,414.22	42,900.70	41,258.49	34,923.71	45,041.05	51,578.60	[1] 132,159.26	46,913.52	46,112.26	472,301.81
Charter expenses	7,608.55	8,063.26	9,136.68	8,940.40	8,048.88	8,911.26	9,995.47	9,686.26	9,373.80	79,764.56
Overhead expenses:										
Traffic expenses	1,898.19	1,634.87	1,725.64	5,881.36	3,385.97	3,681.50	4,964.30	3,439.55	3,891.90	30,503.28
General expenses	2,535.56	2,346.57	2,659.60	3,409.22	3,614.77	3,727.56	3,791.47	3,843.38	3,836.20	29,764.33
Total	$50,991.38	$63,040.81	$69,191.01	$56,616.95	$65,669.84	$72,138.44	$161,778.57	$76,569.22	$76,651.14	$692,647.36
Operating income (loss in *italics*)	*$23,685.97*	*$43,181.54*	*$44,672.69*	*$43,207.07*	*$40,163.32*	*$20,701.84*	*$121,967.71*	*$36,258.52*	*$41,355.02*	*$415,193.68*
Other income (debts in *italics*)	1,247.60	627.34	781.95	356.74	218.18	23.78	100.39	*8.93*	676.84	3,023.89
Net income (loss in *italics*)	*$22,438.37*	*$42,554.20*	*$43,890.74*	*$42,850.33*	*$39,945.14*	*$20,678.06*	*$121,867.32*	*$36,267.45*	*$40,678.18*	*$411,169.79*

[1] This includes $85,000 account loss and damage to coffee, account submerging of barge 11 at Destrahan, La., Apr. 29, 1919.

XIII—The Most Promising Water Transportation Routes

The United States faces enormous demands upon the Federal Treasury for its transportation lines. To meet the deficits accumulated by the railways while under Government control, over a billion dollars is already needed. For the construction of highways, the Federal Treasury is already committeed to the extent of over $250,000,000, and demands are heard for sums far in excess of this.

Whatever may be said for or against Federal appropriations for these transportation routes, it is at least true that the railways and the highways are handling traffic in enormous volume. But the inland waterways on which the Government has already spent such great sums are, as has been shown above, carrying practically no traffic. Unless business can be restored to these waterways it will be as foolish to continue to spend public funds on them as it would be to aid a railway on which trains had ceased to run or a highway which the public had ceased to use.

In view of the facts recited in the previous chapters, it is surely time to deal with water transportation as a business proposition. It is time that the commercial organizations of the country should withdraw their support of the agitation for Government expenditure on waterways anywhere and everywhere, and to demand instead that only such waterways shall be maintained as will carry a traffic to justify the expenditure upon them.

It is time, too, that the stock arguments which have long deceived the public on the waterway question, and which were based on the commercial conditions of half a century ago, should be swept to one side. Water transportation must be measured by the conditions of today and of the future, not of the past.

What the public wants to know, and what the business community wants to know, is: Where can inland water transportation carry traffic more economically or advantageously than the railways? Unless the waterway can show a saving over the railway, its use will be inevitably confined to unimportant local traffic in regions where access to the railway is difficult. Unless the waterways can effect large savings in transportation costs and do business on a large scale, the country's commercial organizations are not interested in their maintenance.

Necessities of Successful Water Transport

From the review of practical experience given in the preceding chapters, it is evident that the following conditions must be fulfilled if a water transportation route is to handle a large business:

1. The cost of handling at the terminals must compare favorably with the cost of handling at railway terminals in the same district.
2. The waterway itself must be sufficiently commodious and safe for economical navigation.
3. There must be a very large volume of business to be handled, because a large proportion of the traffic will go by rail anyway.
4. The waterway transport lines must have an organization capable of rendering reliable, responsible and economical service.
5. Railways competing with the waterways must not be permitted to reduce their rates below the total cost of service.

Taking up the first of these requirements, it is evident that the opportunity for waterways is best where railway terminal costs are highest, and also where waterway terminal conditions are most favorable. These conditions are best fulfilled along the Atlantic coast. In the large seaport cities of Boston, New York, Philadelphia and Baltimore the terminal costs of railways have become enormous, and the cost to shippers of handling freight to and from railway terminals have increased in equal proportion.

On the other hand, in these and other Atlantic seacoast cities terminals for water transport already exist. A very large volume of traffic can reach these water terminals without a rail haul. Thousands of business concerns can deliver by trucks to a pier on the waterfront as readily as they can to a railway station. A great volume of ocean shipping can deliver and receive freight more economically from barges alongside than from the pier.

Thus conditions 1 and 3, noted above, are fulfilled. The ocean, open and free for coastwise navigation, fulfills condition 2. Condition 4 is also fulfilled, so far as coastwise traffic is concerned, by the existence of long-established steamship lines. Reference has already been made to the financial difficulties of the coast lines. In order that condition 5 shall be fulfilled, there must be an advance in railway rates to the great seaport cities.

Railway Terminal Costs at Seaboard Cities

Few even among railway officers appreciate the very heavy expense involved in the operation of railway terminals in a great city, when the capital charges on these terminals are included. Railway rates are still based primarily on distance, although the cost of the service rendered often varies far more with the relative cost of handling in different terminals than on variations in the distance hauled.

Furthermore, cost of service has been practically ignored in the railway rate structure. Railway accounting has paid little attention to the cost involved in handling various classes of traffic in various locations. The question has seldom arisen in a practical form in the making of railway rates.

In the situation here discussed, however, it becomes an intensely practical question. If a waterway can carry traffic on the whole more cheaply than the railway can, then it is in the public interest that the waterway should be maintained and operated. In order to settle this, the cost of handling railway traffic must be found. It is known that on the present scale of wages and prices the railways on the present scale of rates are falling short of earning a fair return on the capital invested. If railway wages and other expenses cannot be reduced, then railway rates must be increased, and Director General Hines has recently declared that an increase is inevitable. If a rate increase must be made, it should certainly be made where it is known already that the cost is heaviest, and that is on the traffic handled in great city terminals.

Separate Terminal Charges on Railway Freight

The Hon. Robert W. Woolley, of the Interstate Commerce Commission, has urged a reform in railway rates by which all rates would be determined by adding a flat rate per mile to a fixed terminal charge. Without inaugurating so sweeping a change as that proposed by Mr. Woolley, it should be possible to establish a separate

terminal charge on railway freight to and from great cities where the terminal expenses are heaviest.

If such a terminal charge were made, sufficient to cover the cost to the railway company, it would be the first and most necessary step toward reëstablishing water transportation on the most favorable routes.

The difficulties in obtaining such an advance in railway rates are exceedingly great. The imposition of a special terminal charge to cover the actual cost to the railways of serving shippers at the ports of New York and Boston and Philadelphia and other Atlantic coast cities would be fought by the united commercial and political influence of all these cities. Such a measure ought to find friends and supporters among the commercial interests of other sections of the country which are now being unduly taxed in railway rates to make up the losses in operating the railway terminals in the great cities. But the public is so little informed on these technical questions of transportation cost that effective support for such a reform could not be counted on.

Much the same conditions exist with regard to the general proposition to raise railway rates to points where water competition was once effective. The cities and sections which have long had the commercial advantage of such rates will be vociferous in opposition. There is not a Chamber of Commerce which has gone on record in favor of Federal appropriations for waterways which would not promptly oppose an increase of the railway rates affecting its city.

This is the condition that confronts the proposal to revive traffic on inland waterways, when considered as a practical business proposition. If traffic by water is to be revived, there must be profits in sight sufficient to induce the investment of many millions of dollars of capital in the building of boats and terminals and in creating business organizations to use them. Even the little experiment in the operation of waterways which the Government through the Federal Railroad Administration is making has involved an investment of over $14,000,000.

Obviously, capital will not invest in boat lines on an inland waterway if competing railways are free to take business away from the boats when they begin operation. Nor do prospects of profit at present rates appear attractive. If the coastwise steamers, which are operating where conditions are most favorable for economical water transport, cannot make money, what prospect of profit has a transport enterprise on an inland waterway?

Let us assume, however, that the difficulties above recited are overcome—or, in other words, that a way is found and put in operation whereby railway rates to points served by waterways will not be reduced below the point which will make water competition impossible. Where are the prospects most favorable for the revival of water transportation?

Waterways Along the Atlantic Coast

We may turn again to the conditions along the Atlantic coast. In the strip of territory extending from Boston on the north to Norfolk on the south and lying within 20 miles of tidewater terminals on the coast, there is concentrated an enormous population and a very large proportion of the industrial plants of the country.

The possibilities of low-cost water transportation to serve this section are already demonstrated by the barges which carry coal from the tidewater terminals on Chesapeake and Delaware Bays to the ports of New York and New England. There is also an extensive and growing amount of local barge transportation carried on all along Long Island Sound and on Chesapeake and Delaware Bays. The completion of the Cape Cod Canal has already connected Buzzard's Bay, at the eastern end of Long Island Sound, with Massachusetts Bay, and has enabled mariners to avoid the dangerous navigation around Cape Cod. If a canal were made across New Jersey from Raritan Bay to the Delaware River at Bordentown, it would enable barges to pass through protected waters all the way from Massachusetts Bay on the north to Norfolk on the south, and thence through inland channels along the coast of the Carolinas as far south as Beaufort.

Barges can at present, it is true, make this voyage, but they must either take the outside route from New York to Philadelphia or use the old Delaware & Raritan Canal across New Jersey. This canal has 13 locks and cannot pass vessels of over 7-ft. draft, yet it still has a traffic of about 300,000 tons per annum.

Ten years ago surveys were made for a deep waterway at sea level across New Jersey, and the project has been studied at various times by boards of engineers. Alternative estimates have been made for a lock canal of 12-ft. depth and 90-ft. width, at an estimated cost of construction of $18,736,000, and a sea-level canal of 25-ft. depth and 125-ft. width, at a cost of $45,000,000. General Black, chief of engineers, on August 9, 1918, recommended the building of the lock canal with provision for its eventual future conversion to a sea-level canal. Secretary Redfield on Sept. 1, 1918, submitted a report to Congress advising the adoption of the sea-level plan. Military considerations have been urged in favor of such a canal, as a protected inland waterway for vessels engaged in coast defense, and this would favor the larger sea-level canal.

The same report by Secretary Redfield also favored the purchase by the Government of the Chesapeake & Delaware Canal, which now passes vessels of not more than 9-ft. draft, and its enlargement to a sea-level canal of 25-ft. depth at a total cost of about $13,000,000. Arrangements for its acquisition by the Government are practically completed. Included in the general project is also the purchase of the Cape Cod Canal and its enlargement to a depth of 30 ft. and a width of 200 ft. at a total cost of about $15,000,000.

It is unnecessary to discuss here the question what size and draft for these three waterways should be chosen to secure the greatest economy. The point to be here emphasized is that the provision of these links would offer increased facilities to a water-borne commerce already existing and for which terminals are already provided and in use.

It is probably true that the advocates of these Atlantic Coast waterways have magnified the dangers of the open ocean passage which these inland canals will avoid, and have underestimated the drawbacks to canal navigation. The Cape Cod Canal has been twice entirely blocked by the sinking of a coal-laden steamer in the channel, once for 12 days and the second time for three months.

Enough advantage has been demonstrated, nevertheless, for these canal routes to make it practically certain that they would command a large business when opened.

The Cape Cod Canal passed 3,800,000 tons of shipping in 1918. The proposed canal across New Jersey would shorten the distance between Philadelphia and New York from 274 miles, the present distance around Cape May, to 87 miles, and would be more advantageous to traffic than the Cape Cod Canal.

It has already been shown that the longer the water route the greater the saving over rail transport. The provision of the three canals above referred to would give continuous, protected navigation along the Atlantic Coast from Beaufort to Boston, a total distance of about 800 miles.

Whether the major traffic on this coastal waterway would be by large barges of 20-ft. or more draft or by smaller craft of 8-ft. to 12-ft. draft is by no means certain. The facts recited in the chapter on the New York Barge Canal, however, indicate that the craft of smaller size have many things in their favor, in actual commercial operation. Not the least of these is the extension of the area reached by water transport. Barges of 8- to 12-ft. draft can ascend the lower reaches of navigable rivers all along the coast to a much greater distance than barges drawing 18 to 20 ft. They can enter harbors and can reach landings which would be inaccessible to vessels of deeper draft, and they can handle freight to and from the smaller industries and towns, where the large vessel would be of too great capacity.

Connecting the Great Lakes and the Atlantic

For a quarter of a century and more, the project of joining the Great Lakes and the Atlantic by a ship canal has enticed engineers and commercial men. In the closing decade of the last century the navigation interests on the Great Lakes succeeded in having elaborate surveys made by the Government of various possible routes for such a canal. It has already been recited how the commercial interests of New York City and Buffalo took alarm at this and succeeded in committing the State of New York to the rival enterprise of a barge canal planned to be big enough to carry freight at very low cost between the terminals but unsuitable for navigation by boats fit to sail the lakes or the ocean.

The ignorance of practical transportation requirements by those who planned the New York Barge Canal is well illustrated by their failure to make any provision for terminals until work on the canal had been in progress for 10 years. Their greatest mistake, however, was in attempting to make a canal which would absolutely require transfer of freight at each end. Competent engineers called public attention to the blunder at the time, but without result.

Possibilities of the New York Barge Canal

There appears no prospect at the present time that the New York Barge Canal, standing by itself, can ever attract traffic enough to justify its cost. Its only prospect of success is in doing what its designers attempted to prevent—connecting the Great Lakes and the Atlantic. Whenever the canal is available for vessels of 10-ft. draft, we may expect to see through barge traffic between all points along the Atlantic Coast from Boston, along the Sound to New York and thence through the canal to Buffalo and to other points on Lake Erie and as far westward as Detroit, perhaps even to Chicago and Milwaukee and Duluth. If the Government opens a sea-level canal across New Jersey and enlarges the Chesapeake & Delaware Canal, then through barges can run between the Lake Erie ports and points on the coast as far south as Beaufort.

The low headroom of the fixed bridges over the New York Barge Canal is not an insurmountable obstacle. With geared turbines and forced draft, a lot of power can be put into a boat without requiring much headroom on board or height of funnels. Of course, it remains to be determined how much traffic could be developed between the southern Atlantic coast ports and the lake cities that would use so roundabout a water route in preference to the direct rail route. That it is practicable to build boats which will be capable of navigating safely the lower lakes, the New York Barge Canal and the Atlantic Coast protected waterways, there can be little doubt.

If such through navigation is established on a considerable scale, it will arouse anew the popular demand in the interior of the continent for direct connection between the Great Lakes and the ocean. That demand found expression a quarter century ago in the projects for a deep waterway to the Atlantic which were recommended by two successive Government boards. Unfortunately, the Mississippi valley interests succeeded in diverting the popular sentiment at Chicago to the support of that will-o'-the-wisp, the Lakes-to-the-Gulf deep waterway project. With the backing of Chicago withdrawn and the opposition of New York certain, it was useless to continue further the agitation for the Atlantic Coast outlet from the lakes.

The old traditions still exist. In the last Congress, a resolution which was adopted to have the International Waterways Commission report on a deep waterway from the lakes to the ocean by way of the St. Lawrence was opposed by the New York and New England delegations in Congress.

That opposition is based on prejudice and on ignorance of the commercial conditions of the present day. In the agitation of twenty years ago to secure the passage of the $101,000,000 bond law in the State of New York, to raise the money for the Barge Canal, the urgent plea was made that the canal was an absolute necessity to save New York City from the loss of its export business and the consequent decline of its commercial prosperity. A score of years have passed by, during which the old canals have lost all their commercial importance and the new canal is practically unused, yet New York and the industries of New England have grown as never before.

Lowering the cost of transportation between the Atlantic Coast and the interior cities on the lakes will benefit the Atlantic seaport cities ten times as much on domestic traffic as any loss of foreign business could injure them.

The St. Lawrence Water Route to the Sea

The experiences of the war, moreover, have been illuminating as to the gateway from the Great Lakes to the sea by way of the St. Lawrence. Lake shipyards contributed splendidly in response to the appeal for ships to win the war, and all their ships had to reach the sea through the St. Lawrence canals.

Except for the war, Canada would by this time have had the work far advanced on its enlargement of the Welland Canal between Lakes Erie and Ontario. This new waterway will have locks 800 ft. long and 80 ft.

wide, with 30 ft. depth of water over the miter sills. It will therefore pass any of the lake steamers and many ocean vessels, all that would be likely to attempt the voyage from the ocean inland to the lakes. This canal with its seven locks will overcome 327 ft. of the total descent from the level of Lake Erie to the ocean.

About one-third the work on this canal has been done. When it is completed, all that will be needed for the free passage of ocean vessels to the lake ports and of the lake shipping to the ocean will be the improvement for navigation of the St. Lawrence from Lake Ontario to Montreal. The total fall in this distance is about 240 ft., chiefly concentrated at a few rapids.

By building great dams across the river at various points, these rapids can be submerged, and the river converted into a series of deep pools connected by locks. The vast water-power created by these dams, in view of the constantly increasing demand for power in this section far removed from coal supplies, would be of enormous value. In fact, plans were made years ago to develop power by damming the river as a private enterprise. The plans failed of execution only because of difficulty in securing the requisite authority from the two Governments.

The Board of Engineers on Deep Waterways, as the result of its investigations twenty years ago, advocated the route across New York by way of the Oswego, Mohawk and Hudson Rivers in preference to the St. Lawrence route. This choice was made because of anticipated difficulties in obtaining joint action by the United States and Canada, with reference to the St. Lawrence route. With the experiences of the war behind us, these difficulties now appear small.

Moreover, much more is known now concerning water transportation than was known when the engineers studied this question a quarter of a century ago. It is very doubtful whether ocean vessels would navigate a deep waterway across the State of New York through such narrow channels as it would be practicable to make in the Mohawk and Oswego Rivers. But ocean vessels could safely and rapidly navigate the broad St. Lawrence from Lake Ontario to Montreal, if the river were converted into deep pools by a series of dams.

In order that the Atlantic Coast shall also benefit by this waterway, all that is needed is to take advantage of the natural route from the lower St. Lawrence to New York by way of Lake Champlain and the Hudson River. The New York Barge Canal will soon afford 12-ft. navigation on this route all the way from New York to Canada. The Government's surveys of twenty years ago showed the great advantage and low cost of this route for a ship canal deep enough for ocean vessels.

Through Vessels from Lake Ports to Europe

It is not intended here, however, to discuss these projects in detail. What is desired is to emphasize the fact that, if money is to be spent for the benefit of water transportation, *it should be spent on channels which will be used when completed.* The governing condition of transportation has been demonstrated to be the cost of transfer at terminals. If the ocean steamer can deliver her cargo directly at a lake port and take on there a load of wheat or dressed meat or steel plates, she can save the cost of rail haul to the seaboard and of transfers of cargo there.

This is not a dream. It is already a reality. On June 25, 1919, the first ocean steamer to sail direct from Chicago to Liverpool left Chicago with a cargo of meat. The steamer is the "Lake Grandby," of 4100 tons, 261 ft. long and 43½-ft. beam. She is limited by the St. Lawrence canals to a draft of 14 ft., but takes on added cargo for her ocean voyage at Montreal.

This is the first of a fleet of 15 vessels under construction for this service by the United States Shipping Board, and it is stated that the rate for the shipment is only $1.25 per 100 lb. The railway rate on dressed beef to New York is 47.5c., and besides this the cost of transfer at New York from car to steamer is saved, with all the chances for delay and injury in this process.

The New York Barge Canal enterprise, on which $150,000,000 has been expended, originated in an engineering fallacy. The theory was propounded that the same vessel could not economically navigate the ocean and the lakes and the channels connecting them. The originator of that fallacy failed to understand how large are the terminal and transfer expenses compared with the cost of movement. If transfers in transit can be cut out, the saving is so great that a ship need not be the most economical for either ocean or lake service. The lake harbors and connecting channels limit the draft of vessels to 21½ ft., but a very capacious and seaworthy vessel can be built on this draft.

Again, the opening of such a waterway would permit lake vessels to pass out to the seaboard at the close of navigation and engage in ocean commerce. It is doubtless true that for the special ore and coal carriers on the lakes it would often be difficult to find profitable business during the winter on salt water; but this does not apply to other classes of boats, and there is good reason to believe that a compromise type of boat would be promptly developed, able to navigate either the lakes or the ocean economically.

Of course, if a large traffic is to be built up at the lake ports, either by through barges from the Atlantic Coast ports or by ocean steamers, a great deal must be done in the development of economical terminals available for the use of such vessels and with convenient facilities for railway transfer. The lake ports have the best facilities in the world for handling the ore and coal cargoes which form the great bulk of the lake traffic, but very little equipment for handling general cargo.

The Lakes-to-the-Gulf Deep Waterway

A brief word in passing may be given to this project, which attracted so much attention a dozen years ago and even obtained some support from engineers. The distance from Chicago to the Gulf of Mexico by the Illinois and Mississippi Rivers is shorter than the distance to the Atlantic by way of the lakes and the St. Lawrence. The latter route, however, leads directly toward Europe while the other leads away from it.

Nature has made the water route by the St. Lawrence easy to improve for ocean shipping. The river from Lake Ontario to Montreal flows over a bed of Laurentian granite, an ideal foundation for the engineers' structures. The Great Lakes form the hugest fresh-water reservoir in the world, and make the discharge of the St. Lawrence nearly uniform throughout the year.

On the other hand, the water route by the Mississippi valley, while it can be improved with no great difficulty

to be usable by vessels of 8-ft. draft, and is already available for such vessels over most of the distance, cannot be so improved as to be usable by deep-draft ocean freight vessels. If anyone doubts this, attention need only be directed to that portion of the river from Cairo to the sea. This is the ancient delta of the river. Rock lies at an unattainable depth. The slope down which the river flows is so steep that the river finds stability only by lengthening its course and flowing in a succession of sharp bends. When the river is in flood its depth would be sufficient at most points to float ocean steamers, but such vessels have not steering power to cope with the swift current and sharp bends.

During a large part of every year, dry weather prevails over the Mississippi basin, and the river shrinks away to proportions so small that only by the dredging of channels across the bars during the low-water season is the river made usable by steamboats of 8-ft. draft. By no practicable method known to engineers would it be possible to secure a sufficient depth for deep-draft ocean steamers in the Mississippi from Cairo to the sea during the low-water season.

What Can Be Done on 8-Foot Draft?

The literature on waterways which has been poured forth so profusely for many years is so largely based on false assumptions and profound ignorance of practical commercial conditions that it is no wonder the general public, and even many engineers, have fantastic ideas on this subject.

One of the fallacies which has been most diligently spread abroad is that a "deep" waterway is necessary for economical inland navigation. It is worth while to consider this matter briefly.

For ocean navigation, depth of hull is essential to a large-size vessel; a long hull of small depth lacks the necessary strength as a girder to resist the stresses when wave crests far apart lift the hull.

For inland navigation in protected waters, large capacity may be given to a vessel by making the hull broad and shallow. Contrary to the general belief, such a vessel can transport cargo just as economically as the deep-draft ocean vessel, and in many cases at even lower cost. Such vessels are very cheap to build per ton of capacity compared with ocean vessels. Built as barges and propelled in fleets by a single power boat, they are cheaper to operate per ton-mile transported than is an ocean steamer.

Besides this, the shallow draft vessel can be loaded with general cargo or discharged at much less expense than a deep draft ocean vessel, given proper equipment in each case. The cargo in an ocean vessel must be carefully sorted, the heaviest articles at the bottom, the lightest on the top. The cargo must be dropped into or taken out of the hold by hoisting tackle and must be carefully placed, so that injury will not occur from piling goods on top of each other.

With the shallow-draft boat, on the other hand, the load is spread out over a large area, and no such expert work in sorting and stowing is necessary as in loading an ocean steamer.

Of course, a "deep" waterway is essential for channels which have to accommodate lake or ocean vessels built to stand rough weather. For use by barges which traverse waters where some seaworthiness is essential, reasonable depth is also desirable.

But where, as at New Orleans, a cargo must be transferred from an ocean steamer to another craft anyway if its journey is to be continued inland by water, it is doubtful whether there would be any material gain in economy by using a vessel of 14-ft. draft instead of one of 8 or 9 ft. There certainly would not be if the larger cost of making and maintaining the waterway which the boat of deeper draft would require were taken into consideration.

For years the "slogan" of the Lakes to the Gulf deep waterway advocates, when they realized that the project for a ship canal was chimerical, was, "Fourteen Feet Through the Valley." It is an excellent illustration of the slender basis of fact and knowledge on which the waterway agitation was conducted that nobody ever attempted to find out whether a river boat could handle traffic at materially lower cost on 14-ft. depth than on 8- or 9-ft. The mere theoretical supposition that the cost of water transport decreased with increase of depth was sufficient!

The Ohio and Mississippi Navigation

The projects on the Atlantic Coast and between that coast and the lakes which have just been reviewed are all projects for linking up waterways already existing and largely used. Can anything be done to restore water transport on inland rivers? The United States will shortly have spent about $200,000,000 on the improvement for navigation of the lower Mississippi and the Ohio Rivers. It is no longer a question whether it is worth that sum to preserve navigation there. That investment is made anyway and is lost except as benefit may accrue through the use of these rivers for transportation. Their use by the old-time craft and old-time methods is gone, never to return. Can newer methods take their place?

Notwithstanding the disheartening experience of the Inland Transportation Co., reviewed in a previous chapter, and of the practical disappearance of the river as a competitive factor in transportation, there is a chance that the Mississippi may again become an important waterway—and perhaps the Ohio also—provided the task is undertaken with a clear knowledge of commercial requirements.

New Orleans is the most convenient seaport for the entry of goods from tropical America—bananas oranges, and other tropical fruits, coffee, cocoa, sugar, hides, etc. The ocean steamers which tie up along the riverfront at New Orleans can transfer their cargo to river barges lying alongside even more cheaply probably than they can to railway cars. These river barges, drawing, say, 8 ft. of water, can deliver such cargo at St. Louis in two to four weeks. The cost per ton of the transfer from steamer to barge at New Orleans should not exceed 50c. Where automatic machinery is used for handling it may be considerably less. The cost per ton-mile for transport up the Mississippi to St. Louis, if the traffic is handled in large volume, ought not to exceed one mill per ton mile.

It may be possible, therefore, by present channels and present craft, to bring an ocean vessel's cargo to St. Louis, far in the heart of the continent, for a cost of probably $1.50 per ton added to the ocean freight rate.

At St. Louis there is under construction the first large municipal river terminal undertaken on the Mississippi, a reinforced-concrete wharf extending along the

river front for about 900 ft. The structure is 40 ft. in height, with its floor a little above high-water mark. At ordinary stages of the river, therefore, all cargo has to be hoisted 20 to 30 ft. to the pier floor. Cargo may be thus hoisted out with cranes, or inclined elevators may be run up the slope of the river bank. Railway tracks are provided for in the plan, and a belt line of railway has been recommended to enable cars loaded or discharged at the pier to pass to any railway entering the city.

If this terminal proves to be adapted to the work for which it is designed, the way will then be clear for a demonstration of what water transport on the Mississippi from New Orleans to St. Louis can accomplish in economical traffic movement.

The success of this experiment will depend not alone on the boats used and the transfer facilities at each end, but on the organization for carrying on the entire enterprise. In order to be successful, it must handle a large volume of traffic; only by so doing can it justify the investment the city has made in the terminal, to say nothing of the millions the Government has spent on the river and recently on the boats. As has already been pointed out, only by handling a large volume of traffic can an organization of terminal labor be maintained able to handle the cargo cheaply and efficiently.

To handle a large volume of traffic the river route must have the hearty coöperation of the railways and of the shippers. The prosperity of the boats depends largely on the return freight. The railways have great power to divert return freight to or from the boats and to obstruct the movement of freight brought by the boats, through their control of freight-car movements.

If the volume of traffic at St. Louis demonstrates the success of its river terminal, similar structures are likely to be erected by various cities along the Mississippi and Ohio Rivers. Caution is needed here, however. Few river cities can furnish or absorb a sufficient volume of traffic to justify the outlay for the costly terminal and the machinery required to handle freight from a river with 50-ft. to 70-ft. variation in level, or to furnish labor for the operation of such a terminal, ready to handle barge loads without delaying traffic. St. Louis is more favorably situated than are Ohio River cities, also, because interruption of traffic by ice in winter is very short and there are no locks to pass on the voyage.

It is hardly too much to say that the future of inland river transport in the United States depends on the results obtained by the water transport line which the Government has established between St. Louis and New Orleans. Until it is shown that business can be made profitable on this route, no more money should be spent on the improvement of waterways where the traffic possibilities are known to be far inferior.

Water Transport For Local Use

The fact hitherto emphasized, that movement by rail in and about large cities is extremely costly, brings prominently forward an advantage of water transport facilities which has been seldom mentioned. Take, for example, transportation in the vicinity of Pittsburgh. The congestion of the railway tracks in the Pittsburgh district makes transfer of freight by rail for even a few miles very costly. A river barge can transfer freight between a plant on the Monongahela and one on the Allegheny, if both have terminal facilities on the water front, more cheaply and often more promptly than the transfer can be made by rail.

Still more marked is the great advantage of the labyrinth of waterways which constitute the port of New York, in giving a means of direct shipment between any two points on the entire waterfront. An eminent engineer once compared this great extent of waterways to a railway switching yard, costing nothing to maintain, in which a car could be moved from any point to any other point directly, without the great labor and expense necessary where cars are sorted in a railway yard. Here is a case where the local water transportation is saving many millions of dollars annually in the transfer of goods over short distances compared with the cost of moving them on land, either through the streets or on railway tracks. It is very likely that the saving by this local water transportation exceeds the saving made by the water transport on all the inland rivers in the United States.

This is of course merely an extreme illustration of the point here repeatedly emphasized, that terminal conditions and not local conditions determine the cost of transport and the economical route.

A Plea For a Broad View

In conclusion, let it be emphasized that the object of the preceding discussion is not in any sense to oppose water transportation, but to urge that the question should be dealt with on sound engineering and economic principles. The business of the engineer, according to a famous definition, is "to make a dollar earn the most interest." The public funds expended for the development of transportation should be spent on the route or system which will furnish the needed facilities at the least total cost, and that cost must include all the items —not only the cost of the route, of the terminals, and of the equipment, with interest and depreciation allowances, but the cost of operation and the costs incurred by shippers and receivers. Only by such a broad analysis of the problem can a correct solution of the problem of economic transportation be reached and great waste of public funds be avoided.

A Subway System for Marseilles

Since the armistice the population of the French port of Marseilles has increased to 800,000—about double that of thirty years ago—with the result that additional transportation facilities in the form of a system of underground railways have become imperative. The whole question, according to the engineering supplement of the London *Times*, both from an engineering and a financial point of view, has been considered by a special commission appointed by the city. The project contemplates the construction of two lines, with a combined length of about 7 miles, with provision for future extension. The deepest station will be about 80 ft. below the ground surface and will be served by elevators. The normal subway section, providing for two tracks, will have a minimum height of 13 ft. 1½ in. and a minimum width of 22 ft. 7½ in. The stations will be long enough to accommodate trains 236 ft. in length. The width of the subway section at stations will be about 40 ft., with an island platform between tracks, but at special sites the width at stations will be 52 ft. and there will be three platforms, one in the middle and two at the sides.

Variable Designs for County Highway Systems

Suit the Road to the Traffic Is the Advice From Monroe County, New York, Superintendent

IS IT a desirable general policy to permit bond issue legislation or appropriation bills to be so phrased that high-quality macadam-road construction is eliminated?

Is there any evidence that one type of road (say concrete) or that one general type of road (say rigid pavement) is the solution of the complex and exceedingly variable problem of State road design?

Is it wise by legislative action or otherwise to tie the hands of engineers so that they cannot develop a design suitable to each road in question?

Is it wise to ignore the assertions of many engineers based on experience that for the majority of state-county roads (built jointly by state and county) the interest of the community is best served by original construction of thick macadam which, if necessary, can later be surfaced with more permanent materials?

As a contribution to the answers to these questions the experience with macadam roads of Monroe County, New York, is narrated. For the sake of brevity the evidence is presented and the conclusions are stated with the least possible amount of collateral explanation. Both the evidence and the conclusions apply specifically to the county named, but it is believed that they are true in general of all localities in which the conditions are similar.

General Data and Considerations

Monroe County has an area of 62 sq.mi. and a population of 350,000 of which 280,000 are in the City of Rochester. Outside of the city and villages, the county has approximately 1,360 mi. of highway. Of this total 330 mi. are improved state and state-county roads, 700 mi. are improved town roads, and 330 mi. are unimproved roads. The traffic over these roads as determined in 1916 by the State Highway Department is shown by Table I. No increase in the total number of vehicles is shown by the traffic census of 1919, but the percentage of trucks and delivery vehicles has increased from 7 per cent in 1916 to 14 per cent in 1919.

As a rule the roads are so well improved that the use of automobiles and trucks is not handicapped. It is believed that not more than 130 mi. of proposed 430-mi. state and state-county road system will be required to sustain heavy truck traffic because (1) at present about 85 per cent of the trucks used in rural work have a rated capacity of 2 tons or less, and (2) automobile dealers assert that in their opinion ¾ to 1-ton trucks, with pneumatic tire and greater speed, are the coming type for rural use except for freight handling along natural main transportation routes. Large numbers of light trucks do not cause foundation failures of macadam of proper depth although they do necessitate surface oiling or bituminous penetration top courses and in some instances require eventually a topeka mix or a small brick surfacing, to reduce excessive surface maintenance.

Across-county traffic for the past two years of army truck transport trains has tested to the point of foundation destruction the various types of macadam roads in the county. A number of miles of road have failed under this unusual traffic stress. The significant facts, however, are that a very small mileage has failed; that old 6-in. macadam roads built for horse-hauled farm wagons of a gross load of about 5,000 lb., and which have been inadequately maintained, failed for short stretches but did not fail universally; that wherever a reasonable depth of 8 in. to 24 in. of macadam existed no foundation failures occurred, and that there was very little surface failure of penetration bituminous macadam. This experience is not presented to defend the use of macadam for heavy freight routes but it does demonstrate that macadam will serve economically for secondary state and state-county roads.

Experience since 1898 with macadam roads from 6 in. to 24 in. thick indicates that to insure against foundation failure the depths given in Table II are required. These depths permit the use of a moderate number of 5-ton trucks having a gross weight of about 20,000 lb. There is no economy in using less depths.

Local materials fit for macadam, or gravel roads, or for concrete base, are generally abundant. Materials required for concrete pavements must be largely imported and hauled a greater distance than the local supplies. Any hard and fast type, such as a uniform concrete road design, throws out, in many cases, the possibility of the reasonable use of local supplies; greatly increases the initial cost of improvements, and violates the fundamental principle of economic road design.

TABLE I. TEN-HOUR TRAFFIC CENSUS, MONROE COUNTY ROADS, MADE BY N. Y. STATE HIGHWAY DEPARTMENT

Main Traveled Roads: State and State-County					Lighter Traveled Roads: State-County				
	All Vehicles		Trucks and Buses			All Vehicles		Trucks and Buses	
Mileage	Maximum	Average	Maximum	Average	Mileage	Maximum	Average	Maximum	Average
130	2500	800	170	60	200	1100	400	70	20

TABLE II. RECOMMENDED DEPTHS IN INCHES OF MACADAM FOR DIFFERENT CONDITIONS

Subgrade Soil	Cut	Fills Less Than 1 Ft.	Fills 1 to 3 Ft.	Fills Over 3 Ft.
	Class I Traffic: Large volume of ordinary vehicles and heavy auto trucks			
Coarse sand and fine gravel	9	9	9	9
Clay loam	12 to 15	12 to 15	10 to 12	10
Heavy clay and quicksand	20 to 24	20 to 24	12 to 18	10
	Class II Traffic: Large volume ordinary traffic A few heavy trucks			
Sand and gravel	7 to 8	7 to 8	7 to 8	7 to 8
Loam	9 to 12	9 to 12	9	8
Clay and quicksand	15 to 22	15 to 22	12 to 15	9
	Class III Traffic: Moderate volume, ordinary farm loads. Very few heavy trucks			
Sand and gravel	5 to 8	5 to 8	5 to 8	5 to 8
Loam	8 to 12	8 to 12	8	7 to 8
Clay and quicksand	15 to 22	15 to 22	10 to 15	9

NOTE—Under Class III traffic it is better to use the depth recommended for Class II and reduce the width of metaling, if economy is desired, as all improved roads are bound at times to be subjected to the extreme loading produced by heavy trucks.

The figures given are based on the price conditions prevailing from 1910 to 1915 as the county data are compiled largely for that period. Present prices increase the amounts uniformly about 80 to 90 per cent, but do not change the conclusions in any way.

Thick, well-built waterbound macadam roads, with an asphaltic, oil or tar surface treatment, were main-

tained for approximately $500 per mile per annum, under a traffic not exceeding 2,000 vehicles per 10-hr. day with the percentage of trucks to total vehicles as shown by Table I. The life of the top course under such maintenance ranges from six to ten years, after which recapping is desirable. At that time the road can be recapped with the original type of surface, or a higher grade surface can be used.

Penetration bituminous macadam roads entail a yearly maintenance cost under similar conditions of about $350 per mile per annum, and show a length of life for the top course of from 8 to 12 years, when they can be recapped with the same type or with a higher type of surface.

No brick or concrete rural roads have been down long enough to determine a fair average life before resurfacing, but experience in other counties having a large mileage of older roads indicates that brick pavements will not give satisfactory service on the average for over 15 years without resurfacing. About the same length of life will apply to first-class concrete. The yearly maintenance of these types ran about $150 per mile, and consisted largely of work on shoulders, ditches, guard-rail and the repair of cracks.

Concrete roads will stand a much heavier unit of traffic than will macadam roads, but the maintenance and length of life are not greatly affected by the traffic; they are determined by the action of the elements. That is, the life of secondary roads is probably not much greater than that of primary roads, as they are destroyed largely by frost heave, by settlement of fills and by expansion and contraction. On this assumption, allowing for interest on first cost, maintenance and renewals of the road surfaces for a term of 50 years, the macadams have apparently the advantage for secondary roads in final cost as well as in initial cost.

In order to express the experience in the form of figures, using present prices for labor and materials, the following statement is submitted as a fair average:

Satisfactory macadam of the waterbound, oiled and penetration bituminous types, for secondary state-county roads, costs today for original construction, approximately $20,000 to $28,000 per mile, including excavation, culverts, pavement and all incidentals. Satisfactory rigid pavements cost from $35,000 to $45,000 per mile. The cost, including shoulders, of renewing top surfaces is about as follows:

Kind of Surface	Cost per Mile
Waterbound macadam, 16 ft. wide	$8,000
3-in. penetration bituminous, 16 ft. wide	12,000
3-in. topeka mix asphalt, 16 ft. wide	15,000
4-in. reinforced cement concrete, 16 ft. wide	20,000

If these costs are divided by the average life of the surfaces as given, it is seen that macadam is economical for secondary roads, and, in some instances, for main roads, but the fact should not be overlooked that on heavy-traffic roads the continual work required in patching is an "abomination of the Lord." On this score alone, the rigid pavement or topeka mix, or brick surface on old macadam, is desirable, and has been used.

Conclusions from Experience

1—We advocate the original construction of cross roads, in the state-county system of waterbound macadam maintained by surface oiling, utilizing local materials to their fullest extent, maintained by surface oiling.

2—We advocate the original construction of secondary radial roads, in the state-county system, of penetration bituminous macadam, utilizing local materials to their fullest extent, maintained by surface oiling.

3—We advocate the construction of main trunk line state route, heavy hauling roads of rigid pavements, using the best materials that can be obtained, but varying the type to secure, in each case, the cheapest first-cost pavement, always considering the possible use of local materials proper for the type of road in question. For these roads we have no choice between cement concrete, brick, sheet asphalt, asphalt block or stone block on concrete bases.

4—We advocate the gradual resurfacing of the heavier traffic macadam roads with topeka mix, small brick cubes, etc. We have successfully utilized this method in reducing high surface maintenance costs where the macadam foundation was solid enough for the traffic, and have adopted this method for a number of our roads. We have examples which have stood a 10-year test successfully.

5—We believe that the community has been better served by the policy of constructing 10 mi. of macadam instead of a possible 6 mi. of rigid pavement.

6—We believe that the county has been better served in the past and will be best served in the future by variable road designs using for the majority of the mileage modern macadam for the original construction, later modified, if necessary, by recapping with a lower-maintenance-cost surface. We advocate rigid pavements eventually for approximately 10 per cent of the total mileage of our roads and for approximately 35 per cent of our state and state-county system.

Economy of Low Grades for Heavy Railway Traffic

Grade Reduction to 0.2 per Cent. Instead of 0.3 per Cent. Found Advisable for Large-Unit Operations on Heavy Traffic Line

A STUDY to determine the comparative economy of two rates of grade for a low-grade line handling heavy traffic has been made by the Hocking Valley R. R., and shows a marked economic advantage for the lower grade, in spite of the higher cost necessary to obtain it. This study was made in connection with proposed grade reduction and double tracking, and was made with particular reference to the relative economy of ruling grades of 0.3% and 0.2% on the Toledo division, which extends from the Parsons Ave. yard at Columbus, Ohio, to Walbridge, near Toledo, a distance of 125 miles. The heavy traffic consists of northbound coal trains. Two rates of grade, three train speeds and two classes of engines were factors in the problem. The results of the investigation are summarized in the accompanying tables.

This study was made in 1916, prior to war conditions and Government operation, at which time the traffic density had reached approximately 20,000,000 tons per year, which was considered sufficient evidence of the need of a second track. Assuming a train speed of 15 miles per hour as desirable, the saving in cost of transportation per 1,000,000 tons of freight on a maximum grade of 0.2% as compared with 0.3% would be $12,250 with engines of the 2-10-2 and $10,920 with less powerful engines of the 2-8-2 type.

Improvements to obtain the proposed maximum grades of 0.3% and 0.2% would have cost $2,937,869

and $4,413,000, respectively, under the conditions existing in 1916. The additional amount necessary to obtain the lower grade would be $1,475,131, and 6% interest on this additional capital investment would be $88,508. With a minimum train speed of 15 miles per hour, the annual tonnage of northbound freight to produce a net gain equal to this additional interest charge would be 8,105,125 tons and 7,225,143 tons for the larger and smaller engines, respectively.

TABLE I. COST OF HAULING 1,000,000 TONS 250 MILES OVER MAXIMUM GRADES OF 0.2 PER CENT. AND 0.3 PER CENT.

Grade, Per Cent.	Speed Miles per Hour	Weight per Train: Cars and Freight, Tons	Weight per Train: Freight Only, Tons	Number of 50-Ton Cars per Train	Number of Trains per Million Tons	Total Train Miles	Total Cost of Transportation
A. Engines of 2-10-2 Type							
0.2	10	8428	5900	118	170	42,500	$35,700
0.3	10	6691	4684	93	214	53,500	44,940
0.2	15	7229	5060	101	197	49,250	41,370
0.3	15	5740	4018	80	249	62,250	52,290
0.2	20	6022	4215	84	237	59,250	49,770
0.3	20	4767	3337	67	300	75,000	63,000
B. Engines of 2-8-2 Type							
0.2	10	6200	4340	87	230	57,500	40,250
0.3	10	4921	3445	69	290	72,500	50,750
0.2	15	5334	3734	76	268	67,000	46,900
0.3	15	4228	2960	59	338	84,500	59,150
0.2	20	4467	3127	62	320	80,000	56,000
0.3	20	3533	2473	49	404	101,000	70,700

Table I shows the comparative cost of hauling 1,000,000 tons of freight northbound over a 125-mile line having maximum grades of the two rates noted, the cost including the return of empty cars over the division, thus making a total run of 250 miles. The train and engine cost per mile was taken at 84c. for the 2-10-2 engines of 83,000-lb. tractive power and 70c. for the 2-8-2 engines of 60,800-lb. tractive power.

Traffic conditions at that time (1916) indicated the economy of incurring the excess cost to obtain the lower grade, while since then the traffic has increased considerably. For the first half of the fiscal year which ended June 30, 1916, the northbound traffic in through freight trains alone was at the rate of 7,046,166 tons per year, or very nearly sufficient to realize the net amount of $88,508 interest on the higher cost. It was estimated,

TABLE II. SAVING DUE TO LOWER GRADE AT 15 MILES PER HOUR

Tons Hauled	Excess Cost for Hauling Over 0.3 per Cent. as Against 0.2 per Cent.: Engine 2-8-2	Excess Cost for Hauling Over 0.3 per Cent. as Against 0.2 per Cent.: Engine 2-10-2	Per Cent. on Increased Capital Investment of $1,475,131 for 0.2 per Cent.: Engine 2-8-2	Per Cent. on Increased Capital Investment of $1,475,131 for 0.2 per Cent.: Engine 2-10-2
10,000,000	$122,500	$109,200	8.30	7.40
12,000,000	147,000	131,040	9.97	8.88
15,000,000	183,750	163,800	12.45	11.10
20,000,000	245,000	218,400	16.60	14.80

NOTE: The columns of excess cost show the higher transportation cost for the steeper grade, based on the additional capital investment of $1,475,131 required to obtain the easier grade. The two percentage columns represent the same figures reduced to percentages, thus: $122,500 divided by $1,475,131 gives 8.3 per cent.

however, that within two years under normal conditions the northbound traffic would be at least 12,000,000 tons, and that in ten years it would approximate 20,000,000 tons. As a matter of fact, the total traffic for the calendar years 1917 and 1918 was 20,339,000 and 19,416,000 tons, respectively.

The higher cost for hauling different tonnage totals over the line with 0.3% grades as compared with that having 0.2% grades is shown in Table II.

Reduction of all heavy grades to the limit of 0.2% will not be completed for two or three years, but when it is completed there will be seven stretches of this maximum grade, aggregating a length of 38 miles. Meanwhile, the maximum grades against the heavy northbound traffic are two stretches of 0.5%, each one-half mile in length, one of these being through the yard at Columbus and the other being six miles north of that city. There are several places where 0.5% grades are encountered by southbound traffic, but this condition was not considered in the investigation, as southbound trains are rarely loaded to capacity.

With 50-ton coal cars the standard northbound trains consist of 80 cars, the length of the trains being governed at present by the lengths of passing tracks. Locomotives of the 2-8-2 type and 2-6-6-2 Mallet type are used exclusively in this service. Engines of the Mallet type were not included in the study, but would show a rating even better than that of the 2-10-2 engines given in the tables. The trains make the 125-mile trip without change of engines.

Double tracking is a part of the improvement project, and is to be extended eventually over the entire length of the division. At present it has 26.2 miles of double track, while on the single-track stretches there are passing tracks at intervals of about five miles. An 18-mile diversion or change of line is to be made between Columbus and Delaware, Ohio, but construction on this has not been commenced. With the exception of this diversion there will be no heavy earthwork, and few large structures will be required. No work is now in progress, and the latest stretch of the revision, extending 3½ miles south from Marion, was opened for traffic Oct. 1, 1919. Improvements of terminal facilities are being made at both Columbus and Toledo.

Information concerning the study of economic conditions and the improvement works has been furnished by W. Michel, chief engineer of the Hocking Valley R.R., under whose direction the investigation was made.

Long Cableway Supplied French Army Front

After the French had captured a small part of Alsace in the spring of 1915, they built to supply the army holding the front there an aerial cableway about 3.7 miles long, and with a difference in elevation between the highest point and the lowest of about 2500 ft. This section of the Vosges is very rugged, and was not provided with proper roads nor with many railroads, at least with none which were not endangered by the fire from the neighboring German guns. The army engineers, therefore, dismantled a nearby electric railway power station and built a cableway, which was run with the power so developed. The line is in three sections, 10,400, 4440, and 5120 ft. in length, respectively. At the two junctions of the three lines there were stations built for the transfer of the freight carried. The line was an endless single cable system with cars 40 x 27 x 34 in. in volume, suitable for carrying about 550 lb. of freight and spaced on the line every 280 ft. At the end stations the cables ran around horizontal wheels, permitting the free passage of the carriers. The grade of each line changed between intermediate towers of steel framing. The longest span was about 2520 ft. long. A notable feature was the summit station, where the line passed through a tunnel 590 ft. long and 16 ft. square section, so as to screen the operation of the cableway from the enemy guns. The cableway is described in "Le Genie Civil," Nov. 1, 1919.

Have Engineers "One-Track Minds"?

The following editorial is reprinted from the Dec. 26 issue of *The Engineer*, London:

Is there any more tiresome creature in the world than the man with but one idea? We used to know a youth whose single thought was canoes. He talked about canoes, he read about canoes, he dreamt about canoes. Canoes were the last subject in his mind at night and the first in the morning. He became unfit for the society of any other beings but those who also thought of canoes and nothing but canoes, and we believe their society at last cured him, for in the end he sickened of the subject as dipsomaniacs do of alcohol if they are given it in everything.

Specialists of all kinds are very apt to develop this failing, and it is unfortunately encouraged by temporary successes. We remember once at a meeting of the Honorable Society of Cogers—possibly the oldest and at one time certainly the most fascinating Bohemian debating society in London—hearing a brilliant speech on the subject of the hours of shop assistants. It was admirably conceived, delivered with a due regard to rhetoric, and convincing in its conclusions. Speaking of it in terms of the warmest admiration to "the Chair," we were surprised to meet with a cold response. "A good speech," he said, "but I have heard it too often. Mr. So-and-so is a single-speech man; he has no ideas."

Engineers, as everyone knows, are rather prone to talk shop in season and out of season. They are not much worse than the members of other professions—the stage, for example—but they are, we fear, grave offenders. The failing is, of course, to be corrected by wide reading, but particularly by intercourse with men of varied pursuits. We have Bacon's word for it that reading maketh a full man, and conference a ready man. He who combines the two qualities makes the best company.

Young engineers and young scientists generally are, if we may say so, just a little inclined to neglect the broadening of their minds. They allow themselves, too often under the encouragement of their elders, to become wholly absorbed in their work. At science colleges they meet other young men who think of just the things that they think of, and they gradually grow up seeing the world through a narrow slit. The concentration brings to a few great success, but to the many disappointment. It is a common experience that the least zealous students make frequently the most successful men. May it not be because having larger interests they have a readier sympathy with the affairs of others, and so more easily find their way through the world? Perhaps this is the reason, too, why the great universities turn out so much excellent material; the "conference" with many minds devoted to a diversity of subjects broadens the intelligence and develops companionableness.

Work on New York's Rapid-Transit System During 1919

New York City's rapid-transit facilities materially increased during the year 1919, according to a résumé, by Transit Construction Commissioner John H. Delaney, of the construction work under the dual-system contracts during 1919. Track mileage of the two operating companies increased 35.13 track miles during the year, and indications are, according to Commissioner Delaney's figures that 69½ track miles will be added during 1920. The Interborough facilities were increased by 15.77 track miles during 1919, and the New York Municipal (B. R. T.) system was expanded 19.36 track miles. Thirty-seven construction contracts, involving approximately $46,000,000, were under way Jan. 1, 1920 Upon them work amounting to about $10,000,000 was done during 1919. Approximately $10,000,000 worth of work remains to be done on these contracts.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

"An Object of Suspicion"

Sir—In the Dec. 25, 1919, issue of *Engineering News-Record* a standpipe being built for the City of Chicopee was honored with considerable publicity. In justice to ourselves and to the City of Chicopee, we believe this letter should be printed in the columns of your journal, so that the general public may determine whether the standpipe or the man who wrote the articles recently printed by you is "an object of suspicion."

It is our understanding and general practice to be guided only by exact and accurate information in engineering calculations. It is our belief that an engineering paper of your established reputation should print articles only when you are assured the information contained therein is accurate and authentic

It is unfortunately true that our company is involved in a lawsuit with the firm of Andrews, Tower & Lavalle, not necessarily because they are engineers but because of their "malicious interference between contracting parties," in violation of a statute clearly defined in our Commonwealth of Massachusetts.

It is our understanding that when the designs and estimates of Mr. Andrews for a concrete standpipe were not accepted by the officials of the Water Department of the City of Chicopee, Mr. Andrews applied for the supervision of the proposed steel standpipe. When this request was not granted Mr. Andrews then took it upon himself to make as much trouble for the Water Department as possible, and it was only when inaccurate articles regarding our work appearing in the local papers began to affect our reputation and business, that we felt it necessary to take action. Because Mr. Andrews is an engineer, is it right to assume he is not human and cannot err? As a consequence, legal action was taken, and on the advice of our solicitors, no information of any kind was issued from our office. At our request, the City of Chicopee also withheld information from outside interfering parties, but any citizen of Chicopee was given information when he applied for it.

A few weeks ago a representative of your paper called at this office and requested information, so that he could write up an article for publication. We requested him not to do so on account of the impending suit, and promised him access to plans and specifications as soon as our suit was finished. He told us he would not wait, and evidently gathered his data from persons who had no authoritative knowledge of what they were talking about, and the result was a wonderful fund of misinformation and inaccurate data published by you in the two articles appearing in your Dec. 25, 1919, issue.

On p. 1039 you figure a shell tension of 21,000 lb. per sq.in., assuming a rivet efficiency of 70%. Therefore, your shell tension is only an assumption, and as such not worth the paper and ink to print it. On p. 1054 you state "Visitors are not permitted to

go very close and exact measurements of the plates are of course impossible." You then continue, "An examination of the tank, however, showed that the lower plates are no thicker than the $1\frac{3}{16}$ in. specified in the original drawing, that the lower rings about 7 ft. high have butt joints, etc." If visitors are not permitted, how could you examine the tank and obtain the measurements printed which by the way, are not correct?

Again, you give absolutely wrong information regarding the foundation which is considered by engineers who have visited the site to be a fine piece of work, and properly designed to perform its functions.

For your information, full details and specifications have never been submitted to your representative or Mr. Andrews, so that all calculations made by them so far have been assumptions.

We, therefore, feel that your recent articles were not justified. These articles were reprinted in the local papers, and have so alarmed the residents of Chicopee, that families living in proximity to the standpipe are in fear of their lives. We therefore ask that you retract the statements made until more accurate information is available. W. J. WALSH,

Walsh's Holyoke Steam Boiler Works.

Jan. 14, 1920. Holyoke, Mass.

[In reply to the above communication *Engineering News-Record* has sent the following letter.—EDITOR.]

We have your letter of January 14, which we will print in our Letters to the Editor column as soon as possible.

You evidently misunderstand the purpose of the article and the editorial in the issue of Dec. 25 of *Engineering News-Record* which discussed the standpipe at Chicopee, Mass. If you will read the article and the editorial carefully you will find that there is no statement therein which cannot be backed up by facts in our possession. The article was carefully written so as not to accuse you or the designers of the standpipe, if it was not designed in your office, of a dangerous design. It was written, however, to show that there was being built in the City of Chicopee a structure which, from all information which could be obtained, had potentialities of danger. It was not given as our opinion that the Chicopee standpipe would immediately collapse. We did not state that there was criminal negligence in the design or construction. We do hold, however, that it should be impossible in this country for a builder to erect a structure of the size and potential danger of the standpipe at Chicopee without due supervision by parties who have other than a commercial interest in the structure. Our criticism of your company, if any, was due to the secrecy with which you are conducting your operations at present.

Whether you would give us full information on the design at some future date is of no importance now. You would not give us information on it before the standpipe was put in service and subjected to a load which possibly might cause its failure. It should not be possible that a private controversy between a builder and someone not at all concerned with a public structure should so tie up the information regarding that structure as to make it impossible for a published record of its details to be made. The people of Chicopee cannot be concerned with any suit between you and Mr. Andrews, and *Engineering News-Record*, in its interest in engineering structures in general, cannot be so concerned. Had you even offered to let our representative go over the design, so as to satisfy himself as to its details, we might have been so impressed with the detailed design of the structure as to be willing to wait until some closely future time to publish those details. This you refused to do, taking the stand that this was a personal and private matter with which an engineering journal interested in the principles of good engineering could have no part.

You need not be assured again, as our representative assured Mr. Walsh, that our concern in the matter is entirely altruistic. We want to see good engineering design in the United States. From such information as we have—and that information, by the way, is not confined to the report by Mr. Andrews—we believe that the Chicopee standpipe is considerably bolder than would be permitted by good conservative engineering practice. We therefore reserve the right to criticise it when the full design appears, and we further cannot waive our right to have made the statements regarding it which we did in our issue of Dec. 25. We see nothing in those statements that we at this time have sufficient information to correct or retract.

The paragraphs in your letter which deny the correctness of our statements regarding dimensions and foundations of the standpipe can have no weight with thinking people. Unsupported denials get nowhere. If you wish to put your case before the engineering profession no other method will suffice but to give full publicity to the details. In doing this you have the full right to the columns of *Engineering News-Record*, and every effort to give you justice in the description will be made.

An Undergraduate on Engineers' Compensation

Sir—In your article on the 'American Highway Problem," *Engineering News-Record*, Nov. 13-20, p. 856, one of the serious factors pointed out was the scarcity of engineers to complete the work. Why does this scarcity of engineers exist, we may ask? Why are engineering students and graduates leaving their original choice of profession to take up business? It is a simple financial problem and a great many men who come out of engineering school, immediately see a bigger future with less health-breaking exertion in the business field. The technologist of today is grossly underpaid. There will be a greater shortage of technically trained men in the engineering field as long as the payment of young engineers is below that of other professions demanding similar intelligence and training.

The only remedy is a union for engineers to protect their income and force the public to appreciate and to pay for the accomplishments of engineers. Individual and competitive bargaining for engineering positions is a great hold-back to the development of the profession. The day may come when the demand for engineers will not be met alone by those who work merely for the love of their work and not financial benefit. As a student graduating next year, I, with others, have decided that the future of an engineer is too uncertain to compete with other business offerings at hand.

New Haven, Conn. BRUCE M. LARRABEE.

More About Errors in Logarithm Tables

Sir—Seeing the references, in *Engineering News-Record*, Nov. 27-Dec 4, 1919, p. 962 and Jan. 1, 1920, p. 53, to an error in tables in Searles' "Field Engineering" reminds me of getting into a mix-up a few years ago which ended in my assistant discovering that the log cos of 3°99′ in the tables I was using gave 0.94912 instead of 099912. I was disgusted with my stupidity in not seeing the error at the start, it being so plainly evident. I should suppose that in the similar case referred to some one would have resorted to natural functions before quite so much trouble had accrued. My own case caused nothing more than an hour or two of lost time—and some temper possibly. The tables I was using were those of the Geological Survey, and I notice that the error has been corrected.

Rockland, Me. O. H. TRIPP.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Tractor Pulls Fence Posts

By H. H. Sitterley
Bath, N. Y.

THREE men, with a farm tractor operated as indicated by the sketch, pulled fence posts at the rate of one a minute and at a cost of 2c. per post, in opening up a tract of fenced land as a city allotment. The chain, 8 ft. long, was double wrapped around the post

close to the ground and passed over a 2½-ft. "brace," set on end, to the hitch on the tractor. One man handled the chain, another moved and set the brace and the third operated the tractor. Wages were 45c. per hour. This method proved less expensive than pulling with a lever and chain.

New Material Increases Cement Hardening Rate

CONSIDERABLE work has been done by the United States Bureau of Standards on a new material called "Cal," for increasing the rate of hardening concrete mixtures. As noted in the annual report of the director of the Bureau for the fiscal year ending June 30, 1919, this material is essentially an oxychloride of calcium in the form of a dry white powder. It is not deliquescent, as is calcium chloride, and can be packed in bags and handled in much the same manner as hydrated lime. It is added to concrete materials at the time of mixing and is quickly decomposed by the water into calcium chloride and calcium hydrate, the calcium chloride going into solution, while the calcium hydrate largely remains in solid but very finely divided form. Thus the beneficial effects of the calcium chloride as to workability and increasing rate of hardness of the concrete are obtained, together with the probable effects of calcium hydrate as to increase workability and decrease permeability. Tests of 2-in. mortar cubes indicate that the different cements react to "Cal" in different manners. The brand least affected gave a strength in 3½ days equal to the 7-day strength of the untreated mortar, the treated mortar containing an amount of the material equal to 5.5 per cent of the cement. These results were on test pieces stored in water. Test pieces stored in laboratory air gave more favorable results, which would indicate that "Cal" would be very effective in concrete construction exposed in any way to the drying-out action of the air or sun, and in places where it is difficult or impracticable to keep concrete continually wet during its early hardening.

Removable Flume Over Canal Permits Passage of Hydraulic Dredge

THE necessity of providing for the passage of a cleaning dredge through a low-level irrigation canal which passes under another canal led to the installation of a removal section of metal flume in the latter. This work was done for the Cameron County Water Improvement District No. 4 by H. B. Livingston, chief engineer of the Rio Grande Engineering Co., San Benito, Texas, who has described it in a recent issue of the *Highway Magazine*. The dredge has a 6-in. pump and makes a trip about once a year.

Concrete piers 20 ft. apart carry a pair of trussed 8 x 16-in. beams, each having two struts for the truss rod, and being fastened to anchor bolts embedded in the piers. Upon these beams rest the sides of the steel flume. The piers rest on an 18-in. reinforced-concrete slab supported on six round piles driven to 14-ft. penetration on account of quicksand. Shorter lengths of flume extend from the piers to the canal. The section is smaller than that of the canal, but by making a flaring inlet and outlet of concrete a flow of 220 sec.-ft. is passed through the flume with a loss of head of only 0.5 feet.

When it is necessary to remove the flume, the supporting rods are removed and the flume is taken out, a section at a time. The nuts on the anchor bolts are then removed and the beams lifted off. Three handy men can remove or replace the flume, regrouting the joints, in half a day.

Service Tracks Safely Shifted to Road Slab Five Days Old

AFTER the concrete had been laid five days on the 18-ft. concrete road from Cumberland to Amcelle, Md., the industrial railway for hauling dry batches was shifted onto the pavement slab. This five-day age inferred that all five days had been warm and thus the hardening of the concrete had been rapid. A 1:2:4 concrete was employed. The ties were 2-in. plank 6 x 10 in. wide, and were laid directly on the concrete. Commenting on this experience, J. N. Mackall, chief engineer, Maryland State Road Commission, states that "it could not be observed that any damage whatever had been done to the concrete." In cases where earth covering had been used it was necessary to remove this earth from under the ties so that they would rest firmly and evenly on the concrete surface. With ties of uniform thickness the load was uniform. Gasoline locomotives driven by an automobile motor were employed and were operated at a comparatively low speed further to reduce impact stresses. "Shifting the track onto the slab," states Mr. Mackall "very materially facilitates the delivery of material to the work." He says further "that if industrial railways are to be employed to the best advantage, it is highly essential that they be permitted to use the concrete surface at as early a date as is possible and it is believed that five days is not too short a period." The contractor for this work was R. G. Collins, Jr., Cumberland, Md.

NEWS OF THE WEEK

New York, January 29, 1920

Fifteen Firms Unite in Plant Display at Permanent Machinery Center

Exhibit of Non-Competing Products Designed to Serve Both the Foreign and Domestic Buyer—Group of Executive Offices Established

Service to the prospective buyer of construction plant was made available in a new and progressive form this week when the Allied Machinery Center, comprising a permanent exhibit of the products of fifteen non-competing manufacturers, was formally opened by the Allied Machinery Company of America in New York City. The new center, occupying 30,000 sq.ft. of exhibition and office space at Center and Walker Streets, is the first of its kind to be established as part of an educational and sales promotion plan in the field of heavy construction plant. It is comparable, in a way, to the department store idea of merchandizing dry-goods by assembling a variety of products in one building so that the buyer may supply his needs without the inconvenience of journeying to half a dozen stores.

But the idea behind the machinery center project is a broader one than merely making it easy for the machinery buyer to do his shopping. A fundamental aim of the enterprise is the education of the plant user in sound construction economics—in using the right machine and particularly, where the size of the job warrants, the right combination of equipment for doing the work with the maximum of economy and speed. This feature of the plan, it is pointed out, has a special significance at present when the cost of common labor has soared to heights not dreamed of half a dozen years ago.

The machinery center is designed to serve the needs of both the export buyer and the domestic purchaser. With respect to the former the great need abroad is generally conceded to be an appreciation of the results obtainable by American construction methods—which means, of course, the substitution where practicable of machinery for hand labor. This lesson is still to be learned, a fact not fully appreciated by anyone who has not actually been on foreign soil and studied conditions at first hand. As a supplement to the actual machines on exhibit at the center, therefore, there will be representatives qualified to analyze the construction problems of prospective purchasers and suggest the methods and plant equipment best adapted to the work contemplated. In addition a series of motion pictures has been prepared show-

(*Concluded on page* 251)

Research Council Is Endowed In 5-Million Carnegie Gift

The Carnegie Corporation of New York has announced its purpose to give $5,000,000 for the use of the National Academy of Sciences and the National Research Council. It is understood that a portion of the money will be used to erect in Washington a home of suitable architectural dignity for the two beneficiary organizations. The remainder will be placed in the hands of the Academy, to be used as a permanent endowment for the National Research Council.

The Council is a democratic organization based upon some forty of the great scientific and engineering societies of the country, which elect delegates to its constituent divisions. It intends if possible to achieve in a democracy and by democratic methods the great scientific results which the Germans achieved by autocratic methods in an autocracy while avoiding the obnoxious features of the autocratic regime.

Reorganized since the war on a peace-time footing, it is now attempting to stimulate and promote scientific research in agriculture, medicine and industry, and in every field of pure science.

Federation of Construction Industries Plan Annual Meeting

The first annual meeting of the National Federation of Construction Industries is to be held in Chicago at the Hotel Sherman, March 24 and 25. Among the subjects of interest up for discussion at the meeting are freight traffic as affecting the construction industry; freight rates, economical packing and handling, and the shipment of construction materials; standardization in the construction industry; foreign trade, financial relations, including the question of Federal home loans; exemption from taxation of certain of the income from mortgages on real estate, etc.; jurisdiction and awards, housing, and Americanization. The committee in charge of arrangements invite suggestions for other topics to be discussed at the annual meeting. John C. Frazee, executive secretary of the National Federation of Construction Industries, has his headquarters in the Drexel Building, Philadelphia.

Forestry Station for U. of Cal.

An appropriation of $25,000 for the establishment and maintenance of a forest experiment station in co-operation with University of California is provided in a bill which has been introduced in the Senate by Senator Johnson of California.

National Federation of Engineering Societies To Be Created

Governing Boards of National Societies Informally Approve Joint Conference Committee's Report and Request Call for Organization Meeting

Pursuant to a call by Engineering Council the governing boards of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Society for Testing Materials, being the five members of the Engineering Council, met at New York on Jan. 23 to discuss the future work and financing of Engineering Council and any other subjects germane thereto. The principal result of the meeting was a unanimous endorsement by the governing boards of the recommendations of the Joint Conference Committee and the request that the committee call a conference to bring into existence the comprehensive organization proposed.

It was also decided to request action by the individual governing boards increasing the appropriation for the work of Engineering Council from $3,000 each to $5,000, except for the American Society for Testing Materials, which would be increased from $600 to $1,000. In addition it was suggested that each of the boards take under consideration the circularization of their members, except juniors and students, asking them to contribute $2 for the support of the council, the intention being to recoup the societies for their contribution to the council's work. If the contributions exceed the quota, the excess is to go to the council.

The morning session was opened by a statement of the accomplishments of Engineering Council. The immediate discussion looked to an expansion of the council's work, with the thought that the leadership of the national engineering societies therein should in no way be compromised. There was evident from the start, however, even on the part of the older members, a desire to make concessions—in fact, to do almost anything within reason to bring about an effective coalition of all the engineering society forces of the country.

As the discussion progressed, the impossibility of getting an effective organization and one that would appeal to engineers throughout the country, if the present lines of procedure were continued or only slightly changed, became more and more evident. Gradually the idea of standing by the past

was dropped or modified, the tendency being consistently toward an appreciation that in the Joint Conference report all of the factors and elements had been considered and a good solution proposed.

RESOLUTIONS PROPOSED

Among the first suggestions, not embodied however in the shape of a resolution, was one made by Clemens Herschel that Engineering Council be empowered to elect other societies to its membership without referring the elections to the present member societies for approval. The first resolution, however, to get effective discussion was that proposed by Philip N. Moore, saying "that a committee or council should be established which would secure representation of all national and local engineering and allied technical societies along the general lines laid down by the Joint Conference report." This brought out the point of view of the more conservative members that Engineering Council should not be prepared to step out of the field, but should be the body from which all expansion should proceed. To this other members replied that it was the autocratic constitution of Engineering Council which made it mistrusted and that nothing could be successful other than a thorough democratization of the council, which meant the abandoning of present ideas and the throwing of the matter into the hands of representatives of all the engineering societies to work out along the lines of the Joint Conference report.

An element in this discussion was the proposal by Calvin W. Rice of a resolution to the effect that the conference would look with favor on Engineering Council reorganizing itself along the lines of the Joint Conference Committee's report. This resulted in further elaboration of the point of view entertained in the local societies, and was followed by the introduction by Dr. Ira N. Hollis of a resolution providing that a committee composed of representatives of the conference and of local engineering societies be appointed to formulate in detail the report of the Joint Conference Committee, which was to be approved in principle, and that a conference be called to put into effect the recommendations of this committee, the boards of direction of national and local engineering societies being invited to attend or to send representatives. The discussion of this resolution cleared the atmosphere and brought a unanimous feeling that the only way to get effective action was to throw the matter into the hands of the Joint Conference Committee and ask it to father a meeting that would proceed to organize in accordance with the recommendations of its report. Accordingly the Resolutions Committee was requested to take the matter in hand and in conformity with the sentiment of the meeting draft a brief resolution setting forth the matured conclusions of the conference. After a recess to allow the committee to draft the resolution, the body reconvened and, without discussion, adopted the following preamble and resolution:

"Whereas, This conference of national engineering societies has considered the recommendations of the Joint Conference Committee of the four founder societies, Therefore, be it

"Resolved, That the conference adopts in principle that report and requests the Joint Conference Committee to call without delay a conference of representatives of national, local, state and regional organizations to bring into existence the comprehensive organization proposed."

This resolution, it will be noted, makes no reference to Engineering Council. The matter is placed, through the medium of the Joint Conference Committee, entirely in the hands of the conference which is to be called.

During the discussion the representatives of the American Society of Civil Engineers explained that approval of the Joint Conference Committee's report had been referred to letter ballot of the society's members, and that such letter ballot would exceed in authority whatever informal approval the civil engineers board might give in this meeting.

Mississippi Valley States Will Discuss Concrete Roads

A joint conference on concrete road construction will be held on Feb. 3 and 4 in Chicago, under the direction of the Association of Mississippi Valley State Highway Departments. On Feb. 3, an evening meeting will be devoted to showing stereopticon and motion pictures of road structures, designs and plans and of current methods of constructing concrete roads. On Feb. 4, there will be an open discussion on the following topics: Methods of Letting and General Contracting; Methods and Arrangements; Who Shall Furnish the Materials; Payments for Materials Delivered on the Road; Unloading Aggregate from Cars; Producing Materials Locally by Portable Plants; Plants and Plant Layouts; Bulk Cement and Cement Storage; Various Hauling Methods; Stock Piles, When and Where; Preparing the Subgrade; The Forms; The Mixer; Finishing by Hand or by Machines; Curing, and Acceptance and Payments.

Langfitt's A. E. F. Report In Big Demand

The demand for the Historical Report of former Major General W. C. Langfitt, Chief Engineer of the American Expeditionary Forces, and of which a limited edition was printed recently, is so great that a request has been made to Congress that the report be published as a public document. At the Engineer Corps office, more than 1,000 requests for this book are on file. In addition to the demand from individual engineers, many requests for copies are coming from schools and colleges.

Wants Architects To Control Delaware Bridge

Art Commission Says Engineers Are Not Broad Enough To Decide "Where" and "What"

"Certain broader aspects" of the question of the proposed bridge across the Delaware River at Philadelphia have been called to the attention of Governor Sproul of Pennsylvania, by a letter from the State Art Commission. The main purport of the letter is that the engineer is too limited in his appreciation of the problems of art and bridge location to be entrusted with the control of the proposed structure, and that the architect "has the proper training," so the project "should be confided to such a person."

The letter is signed by the Secretary of the Commission. The main text, as published in the Philadelphia newspapers, is as follows:

The State Art Commission has been giving serious consideration to its relation and duties to the furthering of the great project of the Delaware River bridge.

While on the surface a bridge is a structural or engineering problem, for patently it must stand up and do its work, there are other underlying questions which must be answered before anything can be built. We are convinced that the question of "where" and "what" are of greater importance, and more difficult to answer, than "how" to build it.

The question "where," meaning location, can only be really answered after a complete study of the city plan has been made. This study will be undertaken by the City Planning Commission authorized by the new city charter. Should the location be determined without reference to such a study, the Delaware River bridge will become another of the given difficulties complicating such study.

The question of "what" to build, meaning size and kind of structure, can really only be answered after a determination of the kind of service which the bridge will have to perform. As the bridge will be the principal link with that part of Philadelphia's metropolitan district which lies in New Jersey, the zoning or distribution of population, as it will be, must be considered. This will doubtless be done by Philadelphia's Zoning Commission or possibly by a commission of the metropolitan district which has been recommended. Should the bridge be designed without consideration of these matters, it will not be a success, however well built, or however beautiful.

We believe that more of the success of the Delaware River Bridge project depends on the right answer to these questions than on the actual structural problem, of the "how," which is to our mind after all but a detail.

We take the liberty of calling your attention to these aspects of the case as you have been good enough to entrust the duties of the Art Commission to us. It is our conviction that this problem demands the most careful study from every angle. We ask you to seriously consider the advisability of appointing as the head of the Commission on Design of the Delaware River Bridge, a man who by his training is competent to study the "where" and "what," rather than one eminently fitted as regards the "how."

The great bridges of New York have all been planned by architects, though, of course, built by engineers. They are beautiful because they fulfill their purpose, and are fittingly designed, with due consideration to the "where" rather than only the "how." We have in Philadelphia over the Schuylkill for the Pennsylvania Railroad and the Rapid Transit Company, an assortment of bridges which, for pure cheapness we believe cannot be equalled. They exemplify the results of the "how" method perfectly.

To avoid similar results is, of course, the wish and object of all. The type of mind that is trained to study and solve a problem from all its aspects, is the type most likely to steer this problem straight. An architect has the proper training to do this and we, therefore, urgently advise that the direction of the project be confided to such a person.

Fifteen Firms Unite in Plant Display at Permanent Machinery Center

(*Concluded from page* 249)

ing approved practice in the use of machinery in all of the representative types of construction work, such as roadbuilding, earth handling, concrete construction, etc. For the foreign buyer expecially this feature, it is believed, will prove highly desirable, for it will indicate to him that methods of construction in which the machines on exhibit are actually being employed, and which may be entirely unfamiliar to him, are not theories but real facts.

The machinery center consists of two parts. The main display of equipment is staged on the ground floor, while each of the companies forming the pool of exhibitors has an executive office on the second floor. The range of products covers concrete mixing and distributing equipment, mechanical loaders, steam shovel, trench excavator, road-roller, steam boiler, hoisting engine, saw mill, shovels, wheelbarrows, lighting devices for night work, steel forms, industrial track, locomotives, electric transfer trucks, gasoline motors, earth moving equipment including scrapers and cars.

The following firms are represented at the Machinery Center:

Austin Manufacturing Co.; Austin-Western Road Machinery Co.; Barber-Greene Co.; Carbic Manufacturing Co.; C. H. & E. Manufacturing Co., Inc., Clyde Iron Works; Cook Motor Co.; A. B. Farquhar Co., Ltd.; Hydraulic Pressed Steel Co.; Lakewood Engineering Co.; Parsons Co.; Sterling Wheelbarrow Co.; Thew Automatic Shovel Co.; Western Wheeled Scraper Co.; Wyoming Shovel Works.

At a luncheon given Jan. 27 to celebrate the opening of the Allied Machinery Center the speakers included Joshua W. Alexander, Secretary of Commerce, Senator Edge, W. L. Saunders, George Edward Smith, and former Secretary of Commerce W. C. Redfield.

That Government and business must begin at once to work in close co-operation if the opportunities of American industry, particularly as regards export trade, are to be fully realized, was the keynote sounded in the addresses of the several speakers. The chief problems touched upon by Secretary Alexander were those of providing adequately for an American merchant marine and of aiding foreign countries in their problems of reconstruction. With regard to the former, the Secretary of Commerce is a strong believer in the expansion of American shipping activities, but he declared emphatically against any policy which would keep such operations closely under Government management rather than instrust them to private initiative and control. Mr. Alexander also warned against the continuation of the practice of large foreign loans as a means of readjusting exchange rates.

This point was further discussed by Senator Edge. Stabilization of rates of exchange and the stimulation of foreign trade, he stated, can best be accomplished, not by loans, but by the general participation by the American public in the purchase of foreign securities. This means, he stated, offers the quickest and most practical solution to the problem of international co-operation in the work of reconstruction. Senator Edge is keenly aware of the burdens which weigh upon industry in the form of income taxes. In his opinion they must not be increased. He expressed himself forcibly in favor of elmination at the earliest possible date of the present taxes on excess profits.

Not only was the purchase of foreign securities endorsed by George Ed Smith, president of the Royal Typewriter Co., but a plan of wholesale advertising in the daily press, similar to that in the Liberty Loan drives, was sugested by him as the best way of accomplishing the results. He cited as one instance of the startling conditions created by the present abnormal conditions of shipping and rates of foreign exchange the fact that Italy was compelled to pay $33 a ton for coal received from this country. "We must create in this country," said Mr. Smith, "a market for the securities of France, Italy and our other allies. We can do so only by using American methods of selling the plan. That means a big program of advertising. The foreign securities must be taken up not only by the big banker and manufacturer but by the man in the street. This help can be obtained only by means of a widespread campaign of education in the daily press."

The meeting was presided over by Charles F. Lang, president of the Lakewood Engineering Co. and was attended by about 150 representatives of the firms participating in the exhibit at the Allied Machinery Center and their guests.

Philadelphia Mayor Supports Camden Bridge in Special Message

A special message was read by Mayor J. Hampton Moore of Philadelphia before the City Council on Jan. 13, advocating the immediate appropriation of $500,000 by the city for the projected Delaware River bridge to connect the city with Camden. With this appropriation the city's money contribution to the enterprise would equal that of the state, under an arrangement whereby state and city are to share half the cost of the structure and the land cost of the west approach. The mayor in his message strongly urged the desirability of carrying the bridge project through, saying, "We cannot afford to fall behind other great areas of population bisected by waterways, which have provided for expansion by bridge or tunnel construction. It is up to us to provide here for an expansion both of population and of industry which can result only in a greater Philadelphia."

Senate Opposition to Col. Beach's Confirmation as C. of E.

(*Washington Correspondence*)

Some opposition may develop in the Senate to the confirmation of Colonel Lansing H. Beach, as Chief of Engineers. It is anticipated, however, that this opposition will not be strong enough to prevent his confirmation. Some Senators who are interested in putting through the National Department of Public Works have heard that one of the reasons for the recommendation of Colonel Beach as head of the corps is the fact that he is known to favor strongly the retention of river and harbor work by the Engineer Corps. Those of the high officials of the War Department who are anxious to see civilian work retained by the Engineer Corps are said to have insisted on jumping those members of the corps who rather incline to confining the activities of the Engineer Corps to works of a military character. It is expected that the Senate Committee will inquire as to why the seniority rule was set aside in favor of a man who has no war record. Colonel Beach has not been with troops for more than twenty years.

Some are of the opinion that Colonel Edgar Jadwin will succeed Colonel Beach as District Engineer of the Central Division with headquarters at Cincinnati. It also is probable that he will succeed him as well as a member of the Mississippi River Commission.

Name Road Committees of National Research Council

At a meeting of the Engineering Division of the National Research Council in New York City, Jan. 22, a thorough program for research in the field of road construction and highway economics was inaugurated. The division, which operates under the chairmanship of Prof. C. A. Adams, prescribed the duties and appointed the chairmen of three highway research committees in accord with a plan proposed by Anson Marston, dean of engineering in Iowa State College.

Prof. Marston's program contemplates the naming of six committees, in all, for road study. He was placed in charge of the division's highway research and it is believed that he will name the remainder of the technical personnel necessary to complete committees planned.

Of the three committees already named by the Engineering Division, only the chairmen nave been appointed. They are as follows: Committee on Economic Theory of Highway Improvement, Prof. T R. Agg, Iowa State College, chairman; Committee on the Structural Design of Roads, A. M. Goldbeck, engineer of tests, Federal Bureau of Public Roads, chairman; Tests and Properties of Road Materials, H. S. Mattimore, engineer of tests, Pennsylvania State Highway Department, chairman.

Routine Proceedings In Annual Meeting of Am. Soc. C. E.

The proceedings of the morning business session on the first day of the annual meeting of the American Society of Civil Engineers, held in New York City Jan. 21 and 22, were mostly routine matters, and because of lack of space were omitted from *Engineering News-Record's* account of the more important matters connected with the Development Committee's report, as given in detail last week. A summary of the reports and discussion, not previously covered, follows:

The year, financially, has not been so difficult for the Society as last year, according to the report of the Board. The deficit of $20,000 on last year's business has been paid in full and while a temporary loan had been negotiated last autumn for the payment of current bills, the amount was less than necessary for a similar purpose in 1918. Arrangements have been made, effective Feb. 1, 1920, for a reduction in the rate of interest on the $200,000 mortgage debt on the 57th St. Society house from 6 per cent to 5 per cent. Disbursements for the year totaled $218,337.73, including $20,545 for United Engineering Society activities and $36,829.88 for publications.

As a war measure it was decided that no volume of the *Transactions* should be issued in 1919, but it is expected that publication will be resumed this year, according to the report of the Board. The Year Book for 1920 will carry a single alphabetical list of members, without division as to grades of membership, in accordance with the vote of the Society. The Year Book will contain the Roll of Honor to provide a permanent record of those who took part in the war. During the year the Engineering Societies Employment Bureau interviewed more than 20,000 men, of whom 5,377 were registered with the Bureau and 1,256 known to have been placed. A continually increasing use of the Engineering Societies' Library is indicated by an annual attendance of 22,042 for 1919, and the work of the Library's Service Bureau has been considerably expanded.

Following the visit of the engineering delegation to France, a permanent Franco-American engineering committee has been formed of two members appointed by each of the four founder societies.

The following announcements were made of the award of prizes: Norman Medal to Colonel William Barclay Parsons for his paper, "The Cape Cod Canal"; Croes Medal to D. B. Steinman for his paper, "Stress Measurements on the Hell Gate Bridge"; Rowland Prize to O. H. Ammann for his paper, "The Hell Gate Arch Bridge"; Laurie Prize to F. W. Gardiner and A. Johannesson for their paper, "The Manhattan Elevated Railway Improvements," and the Collingwood Prize for Juniors to Floyd A. Nagler for his paper, "Obstructions of Bridge Piers."

A progress report was submitted by the Committee on Bearing Value of Soils for Foundations and it was voted that the work of the committee should be continued. The report pointed out that lack of existing information has made it practically impossible to coordinate results and, therefore, an entirely new start has been made based upon the recommendations of J. H. Griffith, engineer physicist of the United States Bureau of Standards. The committee submitted a tabulation of replies for allowable bearing value of soils in various cities, as well as a standard type of field testing apparatus. The committee made no expenditure in 1919, but it was stated that $3,000 could be used in the near future.

The Committee on Stresses in Railroad Track submitted its second progress report in the form of an extensive outline of tests conducted to determine stresses in rails and ties, with particular reference to speed and the effect of locomotives counter-balance weights. The tests indicated stress distribution in the roadbed. Professor A. N. Talbot, chairman of the committee, stated that the results "should lead to some modifications in railway practice." It was voted that the report be accepted and that the committee continue its work.

No report was presented by the Committee on the Regulation of Water Rights, and after some debate the meeting voted to refer authority to the Board of Direction to discharge the committee if such action should seem desirable after investigating its alleged inactivity.

The special committee on highway engineering was appointed by the Board during the year to keep in touch with the Government's plan for constructing highways and to advise the Society by periodic reports. Other committees in existence during the year were those on: Present practice on the bearing value of soils for foundations; regulation of water rights; stresses in railroad track, and the Committee on Development.

On motion of Lieutenant Colonel F. W. Scheidenhelm it was voted as the sense of the Society that there should be appointed a committee on Water Power Development.

Frank S. Sprague introduced a plea for an increase of pay for men in the military and naval services.

Wood Preservers Meet

The sixteenth annual meeting of the American Wood-Preservers' Association will be held at the Hotel Sherman, Chicago, Feb. 11 and 12. The Association announces that, to everyone interested in the economic position of treated wood, as a factor in conserving forest resources or in maintenance of transportation, the meeting offers unusual opportunity for profit. The program includes a great many technical reports and papers on the preservation of wood.

Contributions from the National Public Works Department Association

By M. O. Leighton, Chairman

PUBLISHER'S NOTE: *The space occupied under this caption is donated to serve as a means of frequent and intimate communication between the National Public Works Department Association and the members of the profession. The contributor takes full authority for the statements made.*

PUBLIC WORKS VS. PUBLIC WASTES, OPENING ADDRESS, PUBLIC WORKS CONVENTION, WASHINGTON, D C., JAN. 13, 1920

Ships always leak. The finest vessel afloat must occasionally operate its bilge pumps. It is a routine incident in ship operation, expected as a matter of course. Water is always coming into the ship, while it is afloat, but it causes no alarm among the passengers and hardly any comment among the crew. But let that leak increase in volume beyond a certain rate and it becomes the crucial feature of the ship's run. Those who are aware of it are greatly concerned.

In like manner all ships of State leak, but the direction of leakage is reversed. Money, for which there is no adequate return to the passengers and crew, weeps through the seams, even if it does not run out through open ports. No one takes a thought so long as this leakage is slow and well distributed. It is tolerated so long as the taxpayer is not pinched to make good the loss. But, as in the case of marine operation, there comes a time when the leakage becomes so great that the taxpayer takes thought of his improvident ways and begins to investigate and protest.

Our Government has always been wasteful in the conduct of its business. This has not been the result of any wrongful intent. Throughout a long period of years it has been accepted by the majority and the occasions have been sporadic when much though has been given to it. Wealth usually begets thoughtlessness as to small wastes. So long as our bank balance is large we are not likely to be vigilant as to the price we pay. A few cents more per pound, a few dollars more per yard are paid without thought or hardship. And this was particularly true with respect to Government expenditures when we lived under an indirect system of taxation. Waste of ten million dollars by the Government was hardly appreciable when spread over the price of 10 million pounds of sugar, 10 million pounds of wool and millions of pounds of everything else that we bought in the open market. But now our system of taxation is direct. Every individual of more than nominal earning capacity is presented by the Internal Revenue Office with a bill for his share. And when our annual peacetime budget runs up to $5,000,000,000, as presented by the Secretary of the Treasury a few days since, we begin to think about that leakage. We begin to look for open ports.

That five billion dollar estimate will be pruned—severely pruned. That means that we must go without some things that wise and prudent men think we need or that it would be to our advantage to have. Are we then so poor as all that? No one believes that we are, and yet our bill is so large that it pinches us to pay. The answer is that we are paying too much for what we get. The appropriations committees in Congress will spend the greater part of their time for the next three or four months in pruning those estimates—a laudable and necessary thing to do under the circumstances. But those hard-working men are saving at the spigot and wasting at the bung-hole. We here assembled are asking them to do the obvious thing. Give the Government a business-like organization. Co-ordinate the functions so that the processes of Government business shall dovetail. Cut out the wastes and the duplications. Abolish the rivalry between departments. We advocate a Department of Public Works not merely to secure technical symmetry in our Federal organization, desirable as that end may be. Our advocacy is, in its essential features, an attempt to close some of those open ports.

When this organization was set up at Chicago I think that none of us—certainly not the speaker—had an adequate idea of the scope of the movement. We saw a loose and inefficient public works organization, divided and sub-divided into many different provinces. As technical men we knew how organically wrong that was. Of the wastes and inefficiencies we were well aware. With the necessity for a co-ordinated structure, by virtue of which the technical and semi-technical fields of the Government could be rendered efficient and business-like, we were profoundly impressed. But that our effort, our idea, our legislative bill would become the cornerstone of a structure embodying efficiency in all departments of Government we could hardly foresee. As an organization our effort is still focused on a Department of Public Works and that alone. But we realize that with that principle established—that example set—reform in other provinces of Government business activity will occur by the mere logic of events. We are pioneers.

This is the reason why our project for a Department of Public Works strikes straight home to the business man, the manufacturer, the contractor and the merchant, all of whom are represented here today. The technical men who met at Chicago last April to set up this organization built better than they knew. While the project retains all the virtues that appealed to us when it was launched—of technical excellence, of rational government organization, of economy and efficiency, we now see that it reaches to national and to business prosperity, to the fiscal welfare of the nation, to the individual welfare of the productive business.

We may as well recognize and admit the fact that individual initiative in America will not continue to be that spontaneous thing that it has been in the past if the rewards are to be divided and a part of them are to be wasted in the support of a chaotic Government business organization. The burdens of every business organization in the country are magnified by Government business inefficiency. We want no good and proper thing to be withheld from our Government nor in turn by our Government. When the time comes for this country to be a $5,000,000,000 country we'll all turn out and pay the bill. But we want true consideration in return for our money. And in mild and respectful suggestion let me say to the political party leaders of the country that the voter who goes to the polls in the future will be thinking more about the size of that annual bill from the Internal Revenue Office and of what the country is getting for it than he will of almost any other national issue—a sordid impulse perhaps, but very human, and very certain and sure.

We are here to resurvey our premises, to review our efforts, and to plan our future course. We are here to expand our organization, to welcome new lines of membership and to establish our cause in the minds of those who doubt. This is a business meeting. We are here to work. Our program is sparsely embellished with social and oratorical periods. We have some very tangible things to work out. The future of this movement will be determined here.

Heretofore our work has been largely educational. Now it must become a positive legislative force. We need the participation of every individual here every minute of the allotted time. The thoroughness with which you do the things allotted to you will be the measure of our success now and in the future. Let us see to it that Washington shall harbor one convention in which the effort and attendance of every delegate is 100 per cent. And let us bear in mind that while we are advocating efficiency in Government performance it may be well for us to set a good example.

Newell on Chamber of Commerce Committee

In a news item published in *Engineering News-Record*, Jan. 22, the name of Prof. F. H. Newell, president of the A. A. E., was omitted from a list of members of a committee of the U. S. Chamber of Commerce, appointed to consider a local Chamber of Commerce referendum of the National Department of Public Works movement.

Drane of Florida, Not Davis

In a personal note published Jan. 15 the *Engineering News-Record* transmitted the misinformation that N. H. Davis of the University of Florida was retained by the Commissioners of Smith County, Tenn., as Engineer of Highways. It is Walter H. Drane, and not Prof. Davis, who was retained.

New York City Postpones Action on Interstate Port Control

By a vote of 14 to 2 the Board of Estimate of the City of New York on Jan. 24 voted to postpone action on the proposed treaty which would put control of New York harbor in the hands of an interstate body. The matter was brought before the board by a legislative committee from both New Jersey and New York which presented a revised version of the treaty prepared by the New York-New Jersey Port and Harbor Development Commission. The Board of Estimate did not debate the matter long but individually the members seemed to feel suspicious of the safeguarding of the city's rights and property under the proposed scheme. The resolution adopted agreed to postpone consideration of the matter until the joint port commission should be prepared to lay before the city a detailed comprehensive plan for the development of the port under the terms of the treaty. The future of the treaty is in the hands of the legislative committees which have not forecast their action.

Idaho Society Merges with A. A. E.

The Idaho Society of Engineers was reorganized as the Idaho chapter of the American Association of Engineers at the annual meeting held at Pocatello, Jan. 12. A charter granting state jurisdiction has been issued by national headquarters, but the constitution and bylaws adopted at the Pocatello meeting provide for the formation of local clubs having broad prerogatives as to their own activities. Every member of the Idaho Society of Engineers, who so desires, automatically becomes a member of the A. A. E. and every member of the latter in the state becomes a member of the Idaho chapter.

Officers were elected as follows: President, E. B. Darlington, chief engineer, North Side Land & Water Co., Jerome; first vice-presidents, Dr. C. N. Little, dean of engineering, State University; E. E. Mobley, bridge engineer, Oregon Short Line Railroad; secretary-treasurer, Capt. E. S. Ayers, State Highway Department, Boise; executive committee, J. H. Wilson, city engineer, Idaho Falls; Harry Dibble, project manager, U. S. Reclamation Service, Burley; Allen C. Merrit, Salmon City.

Papers on the program included "Testing Materials Used in Highway Construction," by Raymond Harsh; "Present and Future Problems Confronting Idaho," by William J. Hall, commissioner of public works; "Outline of Federal Highway Co-operation," by C. H. Purcell, Bureau of Public Roads; "Highway Structures," by J. E. Kirkham, structural engineer, S. Dak.

Salaries of Engineering Teachers

A committee on the salaries of engineers in teaching service has been appointed by the A. A. E. Prof. C. J. Tilden, Yale University, is chairman.

Engineers Receive Pay Increases

By passing the transit construction commissioner's budget for the first half of 1920, the Board of Estimate of New York City on Dec. 31 approved pay increases for the engineers of the transit construction staff. Except for men of $3,750 grade and upward, some of whom received an increase of $250, the increases ranged from $300 up. A bonus of $100 per year, which has been paid since last July to employees who have continued in the service since October, 1918, terminated with the new year, and is replaced by the salary increases.

This result is the outcome of the agitation of engineering organizations, led by the local chapter of the American Association of Engineers, and the Rapid Transit Engineers' Section of the Association, which latter now has about 200 members. L. B. Smith represented the A. A. E., C. W. Baker represented Engineering Council, H. C. Keith the Brooklyn Engineers' Club, and E. P. Doyle the Real Estate Board of New York. In spite of the presentment of facts made by these men, the Board of Estimate delayed action until the last moment. On Dec. 30, at its last regular meeting of the year, it failed to act on the budget, and at the board's adjournment there seemed to be the same situation as existed a year ago, when several hundred of the rapid transit engineers found themselves out of employment on Jan. 2 through failure of the Board of Estimate to make the necessary appropriation. This time, however, the engineers' representatives called the matter to the Board's attention at the moment of adjournment, and a special meeting was called for the following day, when the appropriation was voted.

Civil Service Examinations

United States

For United States civil service examination, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission, for form 1312.

Chief of Road Survey Party, $1,800 to $2,100 per year. File application before Feb. 10, 1920.

Transitman for road survey, $1,200 to $1,800 per year. File application before Feb. 10, 1920.

Highway draftsman, $1,200 to $1,800 per year. File application before Feb. 10, 1920.

Topographic and subsurface draftsman, Grade 1, $5.20 per day; Grade 2, $6 to $7.20 per day. File application before Jan. 27, 1920.

Ceramic assistant, to fill a vacancy at the Ceramic Experiment Station in the Bureau of Mines, Columbus, Ohio, $1,200 to $1,800 per year, and to fill vacancies in positions requiring similar qualifications. File application before Feb. 10, 1920.

Canada

The Civil Service Commission of Canada will receive applications from residents of Canada, qualified to fill the following positions:

Shipyard superintendent, Sorel, P. Q., salary $3,000.

Foresters, salary $1,680.

Junior engineers, initial salary $1,680.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION, 150 Nassau St., New York City; Feb. 9-13, Louisville, Ky.

AMERICAN WOOD-PRESERVERS' ASSOCIATION; Secretary-Treasurer, F. J. Angier, Mt. Royal Station, Baltimore; Feb. 10-12, Chicago.

AMERICAN CONCRETE INSTITUTE; Secretary Harvey Whipple, New Telegraph Bldg., Detroit; Feb. 16, 17, 18, Chicago.

NATIONAL CONFERENCE ON CONCRETE HOUSE CONSTRUCTION; Secretary A. J. R. Curtis, 111 West Washington St., Chicago; Feb. 17, 18, 19, Chicago.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA; 111 W. Washington St., Chicago; Feb. 18-19, Chicago.

AMERICAN CONCRETE PIPE ASSOCIATION; 210 South La Salle St., Chicago; Feb. 20-21, Chicago.

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 1426 Manhattan Bldg., Chicago; March 16-18, Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; Secretary C. E. Drayer, 29 S. La Salle St., Chicago; May 10, 11, St. Louis, Mo.

The Detroit Engineering Society, in joint meeting with members of the American Institute of Electrical Engineers and members of the American Society of Mechanical Engineers on Jan. 9, in Detroit, was addressed by David Hall, designer and engineer for the Westinghouse Electric & Mfg. Co. The address, illustrated with lantern slides, was on the subject of design and application of electric propulsion equipment for submarines, special reference being made to a new double-armature motor designed for use in the latest types of submarines.

The Minneapolis Engineers' Club held its annual meeting in Minneapolis, Jan. 19, and elected A. C. Godward, president; H. J. Myer, vice-president, and Lewis Clousing, secretary-treasurer. The program of the evening was a symposium on city planning, led by Prof. F. H. Bass, University of Minnesota, and discussed by local architects, engineers and town planners.

This subject has become a vital question in Minneapolis. The mayor had appointed a city planning commission in accordance with a legislative act of the last legislature, but the Council had refused to confirm the appointment. One of the councilmen had said, "This Council is gradually delegating its powers to various boards; in a short time we will have nothing left to do. I move this matter be laid on the table," and this had been done.

The club passed a resolution upholding the mayor in his appointment of the commission and appointed a committee of five to appear personally before the Council and urge it to confirm the appointment as a vital necessity for the progress of the city.

The Engineers' Club of Trenton is arranging an industrial service program consisting of twelve lectures for the winter months.

The Northwestern Association of General Contractors will hold its annual convention at Minneapolis, Minn., Feb. 23 and 24.

The Rochester Engineering Society at its weekly luncheon, Jan. 20, was addressed by LeGrand Brown, deputy city engineer of Rochester, N. Y., on the subject of "Automatic Block Systems and Train Rule Instructions."

The Northwest Society of Highway Engineers, at its recent convention in Salem, Ore., elected G. V. Skelton, president; R. A. Klein, vice-president, C. G. Reiter, treasurer; C. B. McCullough, secretary, and C. H. Purcell and S. H. Probert, directors. Attendance at the convention totalled 115. The next meeting will be at Corvallis, Ore., March 13.

The Charleston Chapter, A. A. E., was organized Jan. 13, and at the same the members elected C. K. Harvey, president; G. E. Taylor, Wm. Brewster and C. M. McVey, first, second and third vice-presidents, respectively; C. B. Holchan, treasurer, and G. A. Cunningham, secretary.

The Maine Society of Civil Engineers will hold its annual meeting in Portland, Me., Feb. 4. Beside a business session, an excursion, a luncheon and a banquet the program will include the following papers: "City Charter of Auburn," by H. J. Cook, Street Commissioner of Auburn, Me.; "The Construction and Operation of Plant of the Portland Water District," by David Moulton, Attorney for Portland Water District; "Manufacture of the Warren Standard Printing Papers," by Joseph A. Warren, Mill Manager of the plant of S. D. Warren Co. at Cumberland Mills.

Knoxville Chapter, A. A. E., at a recent meeting, elected Prof. N. W. Dougherty, president; L. W. Frierson and W. W. Carson, Jr., vice-presidents; Campbell Wallace, treasurer, and E. S. Davis, secretary.

The American Concrete Institute's annual convention in Chicago, Feb. 16, 17 and 18, will have reports of a number of new committees on special concrete problems which have recently been organized by the Board of Direction. These comprise a Committee on Contractors' Plants, on the Standardizing of Specifications for Steel Bars

for Concrete Reinforcement, on the Standardization of Units of Design, on the Determination of Proper Unit Values for Vertical Shear in Concrete, and on Different Types of Concrete Floor Finish. Already the Institute has sent out the report of the Committee on Shear and the revised report of the Committee on Concrete Surfaces, which contains a specification for stucco, changed in some slight ways only from the admirably recommended practice which was submitted on that same subject to the Institute last June. Another committee is working on concrete storage tanks and will present an important report in relation to tanks and the storage of fuel oil. Other committees which will report more than progress are those on building blocks and cement products, concrete roads and pavements, concrete aggregate, reinforced-concrete chimneys, concrete sewers, concrete industrial houses, and on fireproofing. The convention is to be held the same week as the National Conference on Concrete House Construction. Monday, Feb. 16, will be entirely devoted to Concrete Institute matters, and on the other two days the sessions will overlap those of the conference.

The Associated Engineers of Spokane have elected the following officers for the year 1920: L. K. Armstrong, president; J. E. E. Royer, E. G. Taber, R. S. Ord, vice-presidents and A. D. Butler, secretary and treasurer.

The Engineers' Club of St. Louis has elected W. E. Rolfe, president for 1920. By virtue of that office Mr. Rolfe will also assume the presidency of the Associated Engineering Societies of St. Louis, which includes the Engineers' Club and the local chapters of the national societies of engineers.

The Detroit Engineering Society held a meeting Jan. 23 at which Martin J. Kermer of the Cannon-Swenson Co., consulting and contracting engineers, delivered an address on "The American Beet Sugar Industry." At a meeting of the society to occur Feb. 6 Prof. Clyde T. Morris will give a talk on "Stress Measurements."

The Albany Society of Civil Engineers held its annual banquet in Albany, N. Y., Jan. 27.

PERSONAL NOTES

RUDOLPH J. WIG, S. C. HOLLISTER and L. R. FERGUSON have formed the firm of Wig, Hollister & Ferguson, engineers, with offices in the Widener Building, Philadelphia, Pa. Mr. Wig for a number of years was engineer-physicist in the United States Bureau of Standards, and at the beginning of the war was assigned to the investigation of concrete ships and later was made head of the Concrete Ship Section of the Emergency Fleet Corporation, which position he held until last fall, when he resigned to enter private practice. Mr. Hollister had his early experience with the Corrugated Bar Co., as an instructor in the University of Illinois, and in structural work on the Pacific Coast. He, too, was associated with the Concrete Ship Section of the Emergency Fleet Corporation, particularly with the design and construction of concrete barges. He was one of the contributing authors to Hool & Johnson's "Concrete Engineers Handbook." Mr. Ferguson, following some experience in engineering and contracting work, became assistant secretary of the Association of American Portland Cement Manufacturers and later was engaged in very extensive investigation work for its successor, the Portland Cement Association. About five years ago he and Mr. Wig made an extensive tour of the country in investigation of concrete in sea water and alkaline waters. The results of the former investigations have been reported in a series of papers on concrete in sea water which were published in *Engineering News*. During the war Mr. Ferguson was general manager of the Liberty Shipbuilding Co., which was building concrete ships for the Government at Wilmington, N. C.

CHAS. EVAN FOWLER, bridge and consulting engineer of New York, has opened an office in Detroit as chief engineer in connection with a proposed suspension bridge across the Detroit River. Mr. Fowler is engaged on preliminary work in planning this bridge and also on a traffic survey. He has designed several large bridges throughout this country, Canada and Alaska, among them are the Niagara railway arch bridge and the San Francisco-Oakland cantilever. It is estimated that the Detroit-Windsor bridge would cost $28,000,000 and require four years for construction.

WILLIAM S. CARUTHERS, formerly division engineer California Highway Commission, in charge of the division centering at Sacramento, has been granted a year's leave of absence and has undertaken the duties of Sacramento County Highway Engineer, succeeding R. M. Morton. George R. Winslow, who has been Principal Assistant Highway Engineer since the formation of the California State Highway Commission, has been appointed division engineer in the Sacramento division to succeed Mr. Caruthers. Mr. Winslow's appointment became effective as of Jan. 15.

PROF. R. B. KETCHUM, dean of the department of civil engineering, University of Utah, has been granted a leave of absence to become the chief engineer of the Soldiers' and Sailors' Memorial bridge across Parleys Canyon on the Bonneville Highway. Howard L. Baldwin is active head of the department, with Clarence C. Jacob as associate. Details in the design of the bridge which will be 200 ft. high and 900 ft. long, will be made by Ware & Traganza, architects, and Frank M. Allen, engineer.

SIR WILLIAM HEARST, formerly Premier of Ontario, has been appointed a member of the International Joint Commission on Waterways, to fill the vacancy caused by the resignation of P. B. Mignault, K. C.

WENCEL L. CUKERSKI, landscape gardener of Grand Rapids, Mich., has been notified that he attained the highest grade in the recent civil service examination for Government recreational engineer, and his early appointment is expected. The duties of the position call for the supervision of utilities layouts in National parks and forests in order to secure the most pleasing scenic effects.

CARROLL R. THOMPSON, formerly principal assistant engineer in the Department of Wharves, Docks and Ferries, Philadelphia, has been named Assistant Director of the Department. He succeeds Joseph F. Hasskarl.

ARTHUR PARKER is the new city engineer of Cheyenne, Wyo.

HALE HOLDEN, regional director, of the Central Western Region of the Railroad Administration's organization, has been elected president of the Chicago, Burlington & Quincy Railroad and the Colorado Southern Railroad, the election to be effective upon the termination of his connection with the Railroad Administration. At the request of the Director General, Mr. Holden has consented to continue as regional director for the present and will probably serve until the end of Federal control.

C. W. BEACH by a decision of the Colorado Supreme Court has replaced E. R. Chew, as irrigation engineer for division No. 2, Colorado.

PROF. ROBERT W. THOROUGHGOOD, of the Delaware State Highway Department, has been appointed head of the Civil Engineering Department in Delaware College to succeed Prof. Allan R. Cullimore, resigned.

MAJOR BJARNE H. GRAFF has taken up his duties as division engineer of the first district of the Georgia State Highway Commission, with headquarters at Savannah.

GEORGE S. O'DELL is the new city engineer of South Charleston, W. Va.

E. H. MCMILLAN has been appointed county road engineer for Gilmer County, W. Va.

JAMES F. PLATT has been appointed chief engineer of the Wyoming State Highway Department. Mr. Platt has been with the State Highway Department for almost a year, his work previous to that time being with the Chicago, Milwaukee & St. Paul, and the New York Central railroads.

W. EDWIN FLORENCE, former New Jersey State Senator, has been appointed a member of the New Jersey State Board of Conservation and Development, succeeding J. Kerney Rice.

CHAUNCEY WERNECKE, formerly designing engineer on port work

in Seattle, has accepted the position of structural engineer on the Skagit River power project which is being planned for the City of Seattle. His work is being done under the direction of C. F. Uhden, the city's chief engineer on the project.

EDWARD M. BURD, former Captain, C. A., U. S. Army, and William C. Giffels, former First Lieutenant, have opened an engineering office in Grand Rapids, Mich., under the name of Burd & Giffels. Before they entered the service, Mr. Burd was for several years with Gardner S. Williams, the Turners Falls Power and Electric Co. and the Chicago Engineering Co., and Mr. Giffels was with the L. E. Myers Co., and the Chicago Engineering Co.

GLENVILLE A. COLLINS, former Northwest manager of the Welman-Seaver-Morgan Co., which position has been discontinued by the company, has opened an office for general practice in mining, civil and mechanical engineering, including material handling problems, in Seattle, Wash. He has also established branches in Portland, Ore., and in Tokio, Japan, and Shanghai, China.

ROBERT E. BARRETT has been elected second vice-president and treasurer of the Holyoke Water Power Co., at Holyoke, Mass., and has resigned his former position of construction engineer with the Turners Falls Power and Electric Co. and general manager of the Connecticut River Conservation Co. Mr. Barrett assumes his new duties Feb. 1.

DR. EDWARD ARDERN, F. I. C., formerly chief chemist, is now consulting chemist to the Rivers Committee of the Manchester Corporation, Manchester, England. He has joined S. E. Melling, F. I. C., consulting chemist to the Salford Corporation, and public analyst for the County of Cheshire, England, in practice as analytical and consulting chemist in Manchester.

J. H. SAWKINS, formerly designing engineer with the General Electric & Mfg. Co., at Schenectady, N. Y., has accepted a position as structural engineer with the High Explosive Division of the Government Ordnance Depot, Dover, N. J.

Tructractor Added to Road-Builder's Equipment

A new machine, called the "Tructractor" and used for conveying materials to and from concrete mixers, has been put on the market by the Clark Tructractor Co., Chicago. This machine has a capacity of 1 cu.yd. of dry mix or 18 cu.ft. of wet mix. It has an all-metal body of the hopper type and automatically spots and dumps its load in any desired place. It will take wet mix directly from the central mixing plant to the roadway or dry mix from storage piles to the mouth of portable mixer without rehandling. It is equipped with wide-face steel wheels to prevent cutting up the finished subgrade.

It has only three wheels instead of the usual four; the load is carried over the two front driving wheels in front of the driver, while the single rear wheel is used for steering. In the automatic dump-body model the driver controls the dumping and operates the machine without leaving his seat, with the load always in front of him.

TWO-THIRDS YARD WET-MIX CONCRETE CARRIER SPOTS AND DUMPS LOAD

The machine is propelled by a standard four-cylinder gasoline engine, operating at speeds varying from ½ to 12 mi. per hour, with an average gasoline consumption of 3 gal. per day. The engine is located over the single rear wheel. Gasoline is supplied from a 3-gal. welded steel fuel tank under the hood. The machine is constructed of metal throughout. Several loaded trailers may be hauled in addition to the full rated load. The machine is manufactured by the Clark Tructractor Co., 1136 S. Michigan Ave., Chicago.

BUSINESS NOTES

GEORGE E. MARTIN, professor of highway engineering at Purdue University, has accepted a position with the road department of the Barrett Co. with offices in New York. Professor Martin has been at Purdue since 1904 with the exception of two years' war service in France with the U. S. Engineer Corps.

HARRY C. MCCLURE, former commissioner of engineering and construction for the City of Toledo, O., has resigned to accept a position with the Toledo Scale Company as engineer of maintenance and construction.

MAJOR EZRA B. WHITMAN, consulting engineer of the firm of Norton, Bird & Whitman, Baltimore, and former Water Engineer of that city, has been appointed Baltimore resident agent for a $2,000,000 construction corporation, the papers for which were filed Jan. 16 with the Maryland Tax Commission. This concern is to be known as the Newark Beacon Corporation. Its incorporators are: Elmer M. Harper, Louis J. Jira and George J. Tinsley, all of Newark, N. J. Under its charter the corporation will have broad powers to construct buildings and conduct business enterprises of many kinds. It is understood its first project will be the construction at Newark, N. J., of a moving picture theater.

SERVICE ENGINEERING COMPANY, 25 Church Street, New York City, has been incorporated under the laws of the State of New York with capital stock of $50,000, to render general engineering service and to specialize in the design of tools, jigs, fixtures and methods for interchangeable manufacturing of motor cars, motor trucks, typewriters, adding machines and other products made in quantities. The officers of the new company are Albert A. Dowd, president; Donald A. Baker, vice-president; Fred E. Rogers, treasurer; Thomas P. Orchard, secretary. The company employs a force of about sixty men, and is prepared to give engineering service on short notice.

R. B. FISHER has been appointed as general sales manager of The Buda Co. in which capacity he will direct all domestic and foreign sales and advertising departments.

J. A. OWEN'S has been appointed resident engineer for the newly established Toronto (Ont.) office of the J. B. Nicholson Co., Ltd., engineers and contractors, of Hamilton, Ont. The company specializes in the design and erection of concrete tanks, storage bins and coal-handling plants.